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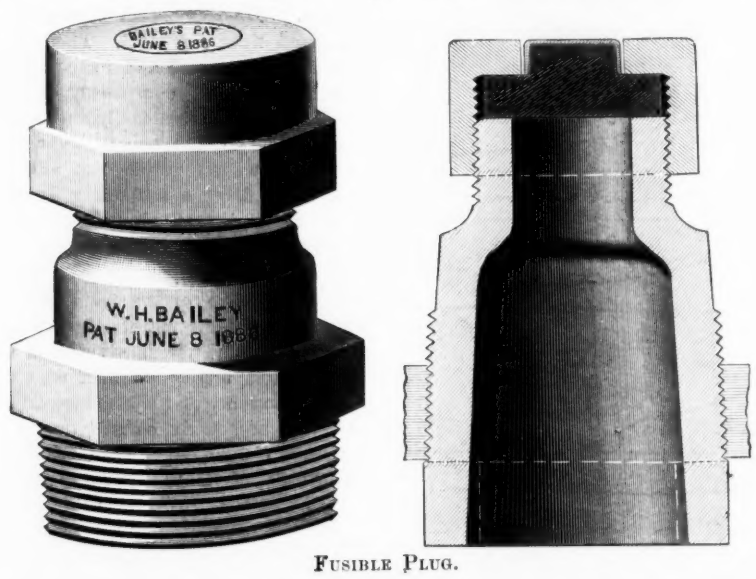
Improved Fusible Plug.

The value of the fusible plug as a safeguard against burning boilers, liable to lead up to boiler explosions, has been recognized for years, and the use of such plugs has been made compulsory in the instance of boilers subject to United States inspection. But to fusible plugs as ordinarily constructed and applied there are serious objections, and these objections are such as to have discouraged those who would otherwise adopt them. For example, such plugs are designed and intended to be an absolute safeguard against the dangers of low water, but they have frequently been found to be nothing of the kind, boilers having in numerous instances been dangerously burned, the "safety" plug remaining intact. The cause of this appears to be that the fusible metal of which the core of the plug is composed is brought into direct contact with the heated water in the boiler, and the base of the fusible metal is, by chemical action, gradually destroyed, its place being taken by a scale deposit forming a substance that will sometimes withstand nearly as high temperature as the metal shell of the plug.

It is evident that a plug subject to such change ceases to be a safety plug, and may indeed become a source of actual danger through reliance being placed upon its operation, and a knowledge of this fact has brought fusible plugs into disrepute.

A fusible or safety plug, to perform the functions that its name indicates, should fuse readily when exposed to the action of the fire, so that if the water, from any cause, gets so low as to nearly reach the point at which furnace heat will contact with sheets unprotected with water, the plug will melt, letting steam into the furnace, thus deadening the fire until the intensity of the heat is not sufficient to do any damage to unprotected sheets. Such a plug should not only be sure beyond any reasonable doubt in its action, but should be so made as to be readily examined, and also to be repaired without unnecessary delay.

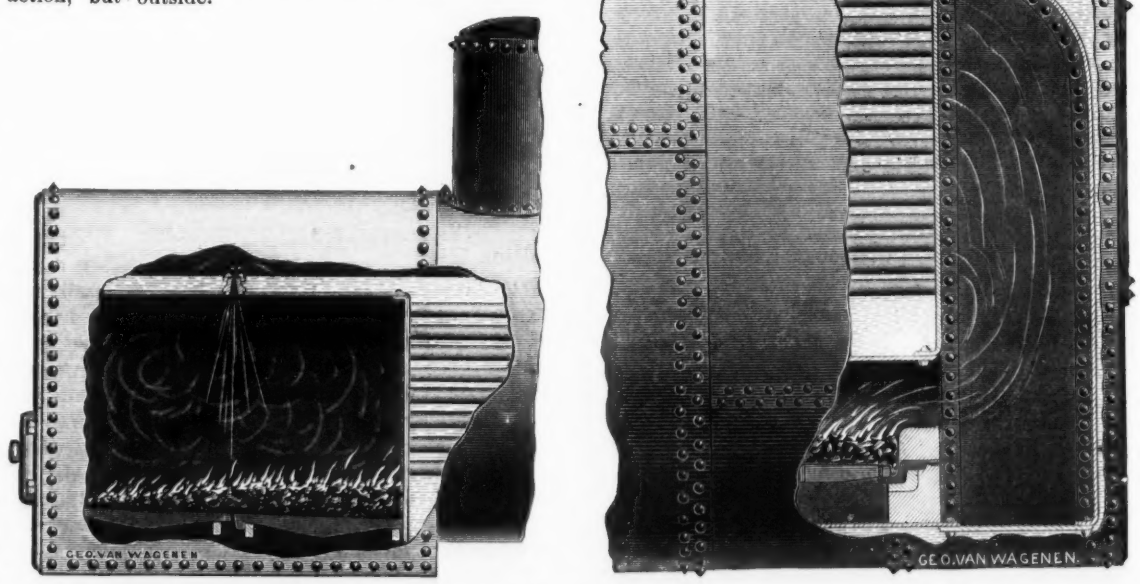
The fusible plug which we illustrate herewith is designed to remove the objections to such devices which we have referred to. It is made in two forms, to be screwed into the sheet from either side. The fusible metal of which the core is composed is covered by a thin copper cap, as shown in the sectional cut. This cap effectually prevents contact of the fusible metal with the water, thereby preventing chemical action between the two, and leaving the fusible metal in exactly the same condition as when inserted, and hence, free to be acted upon by the heat. As applied, the plug extends up into the boiler from 1½ inch to 2 inches; thus it will be melted when there is sufficient water for safety over the sheets exposed to the action of the fire. When the water falls below the point at which the plug is set for, the metal is melted (being kept fusible to the extreme end by the protection of the copper cap) and the copper cap being blown out, there is a free opening of ample proportions for the egress of steam to extinguish the fire, instead of only a small and insufficient opening, occurring quite too late.



FUSIBLE PLUG.

If the accident of low water occurs at a time when it is important to continue operations with the least possible delay, a pine plug may be driven in the opening left by the melting of the fusible metal. In any event it is but a short job to renew the fusible cap, it being only necessary to unscrew the nut and insert a new cap, the rest of the device remaining intact. The small cost of the caps will permit of the engineer's keeping himself supplied with one or more for emergencies.

The smaller cuts show, one in perspective and the other in section, the fusible plug as arranged to be applied, the one from the inside and the other from the outside.



APPLICATIONS OF FUSIBLE PLUGS.

The larger cuts show how the plugs may be applied.

These plugs are the invention of Bailey & Co., of the Albion Machinery Works, Salford, Manchester, England, and are manufactured and furnished in this country by Geo. Van Wagenen, 233 West street, New York.

Railroad companies have for some years taken it for granted that conductors were dishonest, and have used all manner of checks to detect them.

Now it has been suggested that it would be a good plan to pay living wages to conductors, and this is said to have been tried in one or two instances and to have worked very well indeed.

It is claimed that a new method of making glass has been discovered in Sweden, by which the power of microscopic objectives is to be very greatly increased. This glass is said to contain fourteen substances, the most important being phosphorus and boron, which are not found in any other glass.

It is said that the largest cotton mill in the world is in Russia. Employment is given to 7,000 hands.

Compound Engine.

BY W. H. BOOTH.

THIRD PAPER.

When the proportions of a compound engine are such that it becomes absolutely necessary, in order to obtain the power required, to carry boiler pressure through full stroke of the first cylinder, it is by no means necessary that the same fault be continued into the second cylinder, the admission to which should be cut off at quite an early point. Let us suppose an engine in which the proportions of cylinders are as 3 to 9. Then at the commencement of the exhaust stroke of the small piston the steam has a volume = 3. When a third of the stroke has been made, the cylinder volume remaining of the small cylinder is 2, and as the large piston will also have moved through a third of its stroke, the total volume of steam will be expanded to $2 + 3 = 5$. At two-thirds of the back stroke the volume will be $1 + 6 = 7$, and at the end of the stroke it will be 9, or the low pressure cylinder capacity simply. Now, if the low pressure admission is continuous we should obtain diagrams as in Fig. 1 (page 2), the expansion curve falling continuously from the commencement in the large cylinder. If, however, we introduce a receiver between the two cylinders, into which the steam from the small cylinder may exhaust, and from which the second cylinder may draw its supply, we may secure a much more economical result by cutting off the low pressure admission at say half stroke, for example, so obtaining diagrams more of the form of Fig. 2. At best, however, the engine is too small for its work as a compound engine, and would probably be more economical if the small cylinder were altogether discarded. The point is brought up, however, to emphasize the fact that the first cylinder of a compound engine should always be of sufficient size to permit of a certain amount of expansive working in it, as well as in the larger cylinder, and also to further emphasize the desirability of a fairly early cut-off in the low pressure cylinder also.

In every compound engine, whether the pistons work stroke for stroke or the cranks are at right angles, a receiver should be placed between the cylinders. This permits of quite early low pressure cut-off, and prevents the excessive compression such a course entails in the high pressure cylinder when no receiver is employed. Fig. 3 is an exact reproduction of diagrams taken by the writer from a compound engine of the side-by-side or pair type, in which the cranks are at 170° and the general dimensions are as follows:

H. P. Cyl. diam..... 22″

L. P. cylinder diameter	38″
Stroke of each	4′ 6″
Revolutions per counter	53.053
Crankshaft, diam. at middle	15″
Diameter of necks	10½″
Length "	18″
Ratio of cylinder volumes	⅓
Area of H. P. cylinder, deducing area of rods	364
Ditto of L. P cylinder	1118
Constants (H. P.	5.266
Constants (L. P.	16.175
I. H. P. (H. P.	186.44
I. H. P. (L. P.	145.26
Feed temperature	79°.1
Hot well	103°.0
Atmosphere	61°.8
Condensing supply (river)	67°
Vacuum, per gauge	26.78″
Barometer	30.25″

Though only slide valves were employed (the high pressure cylinder had a variable automatic expansion), the fuel consumption was under 2 pounds per I. H. P. per hour of fine dust coal, so fine, indeed, as to require thorough wetting before firing. The high pressure cylinder alone was jacketed, and the receiver was of about the capacity of the small cylinder. The excellent result obtained is simply due to correct design and good workmanship. Instances of considerable saving by cutting off admission to the low pressure cylinder are common, and it may be laid down as a general rule that the cut-off in the large cylinder should be as early, or nearly as early, as that in the first cylinder. This, of course, is not a rule that can be invariably followed in practice, because there may be circumstances preventing this. For example, the small size of the passages and parts connecting the two cylinders is often held to be a bar to early low pressure cut-off in engines having this very common form of mal-construction. It will be well here, however, to call attention to the too little known fact that the volume of steam which will escape through any orifice is practically constant at the pressures found between the cylinders of a compound engine. This being so, it follows that greater weights of high pressure steam can pass them at low pressure, and it would thus appear that by raising the intermediate pressure by means of an earlier low pressure cut-off, we render the steam better capable of passing freely through the contracted passages.

The argument against early cut-off, on account of small passages, has less weight than at first it seems to have. It cannot, however, be altogether ignored, for it appears probable that when backed up the steam will be more moist than when more expanded, and so its flow will be impeded. Generally, however, it will be safe to use the earlier cut-off as a remedy in correcting poor diagrams and saving fuel, and as this can be done very easily the expense is not great, and so long as the very steam port itself is not made seriously small by the increased lap of the valve, the smallness of the connecting passages need not be seriously considered.

In the case of engines with cranks at right angles it is specially desirable that the low pressure cut-off should take place before half stroke. If this is not done there will be a second admission of steam to the large cylinder, which will cause a hump in the middle of the expansion line of the diagram, which, representing an admission of steam upon a piston whose stroke is already half accomplished, signifies a direct waste. The low pressure diagram of Fig. 3*a* shows this hump as a flattening of the curve merely, whilst in Fig. 4 the result of the same action is exemplified in the diagram there presented from a high pressure cylinder of a compound engine, wherein it will be observed that the exhaust line, which commences to gradually cushion up, takes a sudden downward drop as a result of the low pressure valve opening. But for this the exhaust line would have continued as it commenced, and followed the continuous curve we have sketched in or thereabouts.

Practical experience seems to have shown that engines with cranks at right angles give better results in respect of steady turning in cotton mills than when the cranks are placed opposite, or nearly so, though possibly better economical results as regards steam consumption may be obtained with cranks directly or almost directly opposite.

The Art of Firing.

By a Fireman.

It is a common saying that a good fireman is worth any money. Certain it is that his wages form a small item as compared with the value of the material with which he deals—fuel—and the difference between a good and a poor fireman is often measured by many tons of coal in the course of a week.

A fireman's duty is often heavy, and we are sometimes asked how much coal one man is able to use in a week's time. The largest record of which I can speak with certainty is that of the fireman in a cotton factory, who, with five large boilers of the double furnace or Lancashire type, consumed no fewer than 80 tons (2,240 pounds each) in the week of 56 hours. He not only did this, but also wheeled away the ashes to the dump. This man applied for an increase of pay and was refused it. He left, and his place had to be filled by two others, no single man being found able to do the work.

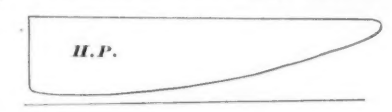


Fig. 1

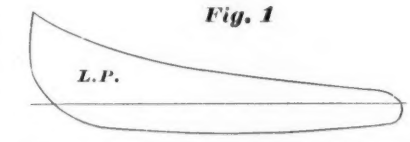
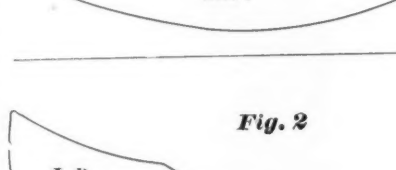


Fig. 2



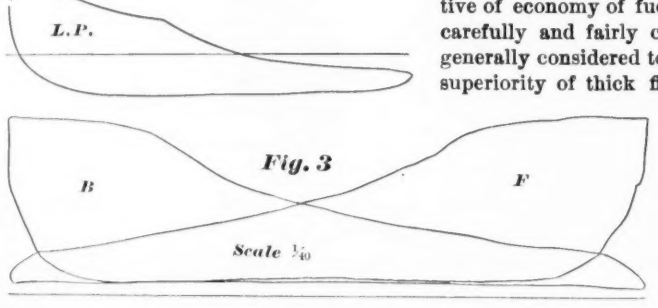


Fig. 3

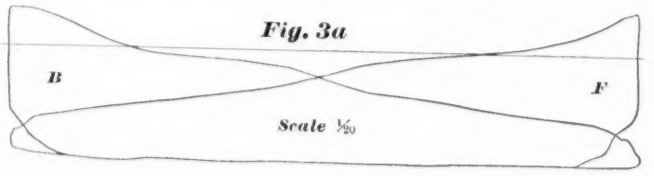


Fig. 3a

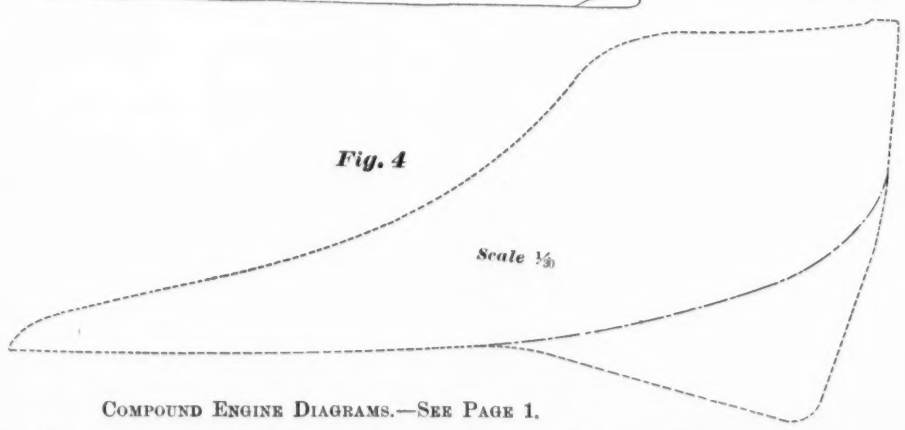


Fig. 4

Compound Engine Diagrams.—See Page 1.

In another case I found one man burning 75 tons weekly (56 hours) in 3 Lancashire boilers, or at the rate of 12½ tons per furnace. Each furnace was 6 feet long by 2 feet 9 inches wide on the grate. The rate of combustion was therefore about 21 pounds per square foot per hour, or about the maximum economic rate for North of England coal. As in the former case, such an amount is too great to be expected from one man, and generally we would lay down 50 tons as a limit in even well-ordered establishments. Much, of course, depends upon the nature of the coal used. Some firemen prefer such a method of firing as preserves the fire surface in a constant steady flame. They fire thinly and often, scattering a small quantity of fresh fuel over the burning surface at short intervals and maintaining a constant damper. This method has its disadvantages, for the constant opening of the fire door admits large quantities of cold air into the furnace, and this is not merely wasteful, but positively injurious to the boiler, especially if of the internal flue type, for the strains set up by the constant variations of temperature are very severe, and grooving is often engendered or made worse thereby. With mechanical systems of stoking these same objections do not hold good, and the sprinkling system is as yet almost the only one in use when mechanical stokers are employed. Where the fireman is sufficiently skillful, and especially when there is a good draft, it is an excellent plan to fire very thickly and in large quantities, heaping the fuel higher at the center of the grate, and piling it within quite a few inches of the furnace crown. By this method combustion is rendered nearly perfect. The gases first distil from the coal and a sheet of flame is produced which completely envelops it. Combustion can be easily and well regulated by the damper, according as the steam gauge shows is required, and with such a system of firing a self-acting damper will be found to give an almost perfect steady supply of steam.

In a series of trials made in England to test the value of certain steam coals it was found that successive increments of thickness of five from six inches to nine, twelve, and finally fourteen were productive of economy of fuel. These trials were carefully and fairly carried out, and were generally considered to have established the superiority of thick fires over thin on the score of economy. The reason for this appears largely to lie in the diminished chances for bare or thin places on the bars, so preventing in rush of large volumes of cold air, which experience shows is so exceedingly wasteful. In respect of the production of smoke, it is often observed that a cessation of smoke is accompanied by an increase in coal consumption. This has been variously explained. By some it is attributed to the above named too great influx of air. By others to the reduction of the soot by absorption in the carbon dioxide gases, which result from complete combustion, and which, at a high temperature, are capable of absorbing carbon with great reduction in temperature through the change of the absorbed carbon into the gaseous form in which it exists as carbon monoxide. The heating effect of the first oxide of carbon is only a third that of the same carbon reduced to its dioxide. There is a third reason for the loss which may accompany the disappearance of black smoke. It is well known that solid bodies are better heat radiators than gases. A clear transparent gas in a boiler flue does not radiate heat freely upon the plates of that boiler, but if such gas is loaded with solid carbonaceous particles these acquire heat by absorption from the hot gases in which they are being carried along, and, in turn, radiate such heat, which is absorbed by the boiler. Black smoke, therefore, may be economical by reason of this physical property, and perfect combustion may be wasteful, simply because of the lack of radiating power of transparent gases.

Modern Locomotive Construction.

By J. G. A. Meyer.

SIXTY-FIRST PAPER.

Counterbalance, continued.

In order to become familiar with the principles given in our previous papers we will apply these principles to a simple case.

Ex. 75. Let *a* in Fig. 379, page 3, represent the center of the axle, *b* the center of the crank pin, the distance between these two centers is 12 inches; *i j k l* represents the cast iron crank, which is of uniform thickness. The weight of the crank is 250 pounds. In addition to this weight of the crank, another weight *m* of 100 pounds is applied to the centre *b* of the crank pin. One view of the counterbalance is shown by the outline *e d f h*, and all the dimensions of the counterbalance except its thickness are given. The edge *f h* of the counterbalance is to be placed 11 inches from the center *a* of the axle; the center line *o p*, and the center line *a b* of the crank are to lie in one straight line *o b*. It is required to find the weight of this counterbalance, which will hold in equilibrium the sum of the weight of the crank and the additional weight of 100 pounds applied to the center *b* of the crank pin. It is also required to find the thickness of the counterbalance. Our first step will be to find the center of gravity of the crank and also the center of gravity of the counterbalance.

In order to avoid hereafter a misunderstanding, we deem the following remarks necessary. In these calculations, and in fact for all calculations employed for determining the counterbalance in locomotive wheels, we only need to know the positions of the centers of gravity, that is to say, we need only to know the distances of the centers of gravity of the crank and the counterbalance from the center of the axle. Hence, for the sake of brevity, we shall speak of the center of gravity as if it was located in the surface of the crank or counterbalance, whereas in reality the center of gravity lies in the center of the thickness. Thus, in saying that *G* is the center of gravity of the crank, it must be understood that the point *G* simply indicates the distance of the center of gravity from the center of the axle, or the position it occupies between the center *a* and *b*.

To find the center of gravity of the crank, cut out a templet to the shape of the crank, and in this templet draw the center line *a b*. Anywhere near the edge of the templet punch a small smooth hole *n*, and then suspend the templet by the hole *n* from a pin, as shown in Fig. 377, allowing it to have freedom to oscillate. From the same pin suspend a plummet line and mark off the point *G* in which the plummet line intersects the center line *a b;* this point *G* will be the center of gravity of the crank. Suppose, now, that by this method we have found the distance between the center of gravity *G* and the center *a* of the axle to be equal to 3½ inches.

To find the center of gravity of the counterbalance *e d f h* we proceed in a manner as shown in Fig. 378, and explained in our last paper. Also assume, that by this method we have found the distance between the center of gravity *C* and the edge *f h* to be equal to 4½ inches.

Since the distance between the edge *f h* and the center *a* of the axle has been given, namely, 11 inches, it follows that the total

distance between the center a and the center of gravity C must be equal to $11''+4\frac{1}{2}''=15\frac{1}{2}$ inches.

Our next step will be to find the weight, which, when applied to the center b of the crank pin, will have same effect in producing rotation of the crank around the center a as that of the weight of the crank applied to its center of gravity G. This weight is found by Rule 40, given in the 59th paper. Hence we have

$$\frac{250 \text{ pounds} \times 3\frac{1}{2} \text{ inches}}{12 \text{ inches}} = 72.91 \text{ pounds.}$$

This weight of 72.91 applied to the center b will have the same energy to produce rotation as the weight of the crank (250 pounds), applied to the center of gravity G, and therefore the 72.91 pounds applied at b will require the same counterbalance as 250 pounds applied at G.

But to the center b of the crank pin is to be applied an additional weight of 100 pounds, represented by m. Consequently, the total weight applied to the crank pin, and which must be counterbalanced, is 172.91 pounds.

We may now reduce our problem to a very simple one. Thus: Fig. 380. Let the line $c\,b$ represent a straight lever, and a its fulcrum; the distance between the fulcrum a and the end b of the lever arm is equal to the distance between the center of axle and the center of crank pin, namely, 12 inches; and the distance between the fulcrum a and the end c of the other lever arm equal to the distance between the center of the axle and the center of gravity of the counterbalance, namely, $15\frac{1}{2}$ inches. Now we know that the weight applied to the end b is equal to 172.91 pounds, consequently all we have to do is to find the amount of weight, which, when applied to the end c, will hold the lever in equilibrium. To find this weight, or, we may say, to find the weight of the counterbalance for any given weight on the crank pin, we have the following rule:

Rule 41. Multiply the distance in inches between the center of the axle and the center of the crank pin by the total weight in pounds applied to the crank pin, and divide this product by the distance in inches between the center of the axle and the center of gravity of the counterbalance; the quotient will be the weight in pounds of the counterbalance.

According to this rule we have

$$\frac{172.91 \text{ pounds} \times 12 \text{ inches}}{15\frac{1}{2} \text{ pounds,}} = 133.86 \text{ pounds,}$$

which is the weight of the counterbalance.

In order to find the thickness of this weight or counterbalance, we must first find the number of cubic inches contained in the counterbalance. One cubic inch of cast-iron is generally reckoned to weigh .26 of a pound; hence the following rule:

Rule 42. Divide the number of pounds in the counterbalance by .26; the quotient will be the number of cubic inches in the counterbalance.

The number of pounds in our counterbalance is 133.86, consequently, according to Rule 42,

$$\frac{133.86}{.26} = 514.84 \text{ cubic inches}$$

in the counterbalance.

To determine the thickness of the counterbalance we have the following rule:

Rule 43. Divide the number of cubic inches contained in the counterbalance by the area in square inches of its face; the quotient will be the thickness of the counterbalance.

The area of the face $e\,d\,f\,h$ is found by multiplying one half the sum of the parallel sides $e\,d$ and $f\,h$ by the length $o\,p$ of the weight, the product will be the number of square inches in the surface $e\,d\,f\,h$. Thus:

$$\frac{7'' + 3''}{2} \times 8'' = 40 \text{ inches.}$$

Now, according to Rule 43 the thickness of the counterbalance will be

$$\frac{514.84 \text{ cub. ins.}}{40 \text{ sq. ins.}} = 12\,87 \text{ inches.}$$

say $12\frac{7}{8}$ inches.

Generally in locomotives there is not sufficient room for a counterbalance $12\frac{7}{8}$ inches in thickness, consequently we must employ two weights, each similar in form to that shown in Fig. 379, so that the thickness can be reduced and still have sufficient weight for counterbalancing the weight applied to the crank pin.

Ex. 76. Let $i\,j\,k\,l$, Fig. 381, represent the same cast-iron crank of 250 pounds, and m the same additional weight of 100 pounds applied to the center of the crank pin, as given in Example 75. The sum of the weights of this crank and weight m are now to be counterbalanced by two weights whose dimensions, except their thicknesses, are given, and these dimensions of each weight are the same as those of the weight given in Ex. 75. The space between the two weights is equal to the thickness of the spoke of the wheel; the weight of the spoke, as in the previous example, is, for the sake of simplicity, left out of consideration. The edge $f\,h$ of the upper weight is to be placed 11 inches from the center a of the axle, and the same distance is to be maintained between the edge $f_2\,h_2$ of the lower weight and the center C nor the center C_2 can be the center of gravity of the whole counterweight $e\,d_2\,f_2\,h$; we must therefore find a new center of gravity N, or we may say a common center of gravity of the two segments $e\,d\,f\,h$ and $e_2\,d\,f_2\,h_2$. To find this new center of gravity we simply join the centers C and C_2 by a straight line; the point N in which this line cuts the horizontal line $r\,b$ will be the center of gravity required. Now assume that, by this construction, we find the distance between the center of gravity N and the center a of the axle to be equal to fifteen inches, we have then all the data necessary for determining the weight and thickness of the counterbalance.

In fact, we may now reduce our problem to that of the simple straight lever, as shown in Fig. 380, in which the line $c\,b$ represents the lever, a the fulcrum, $a\,b$ a lever arm 12 inches long, and $c\,a$ the other lever arm 15 inches long. To the end b is applied a weight W of 172 91 pounds. It is now required to find the weight R, which, when applied to the end c, will hold the lever in equilibrium. It will be noticed that the only difference between this problem and the previous one represented by this figure

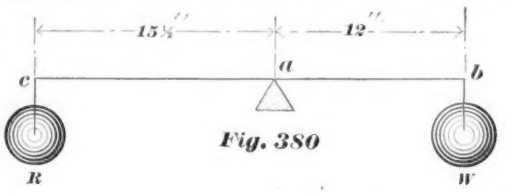


Fig. 380

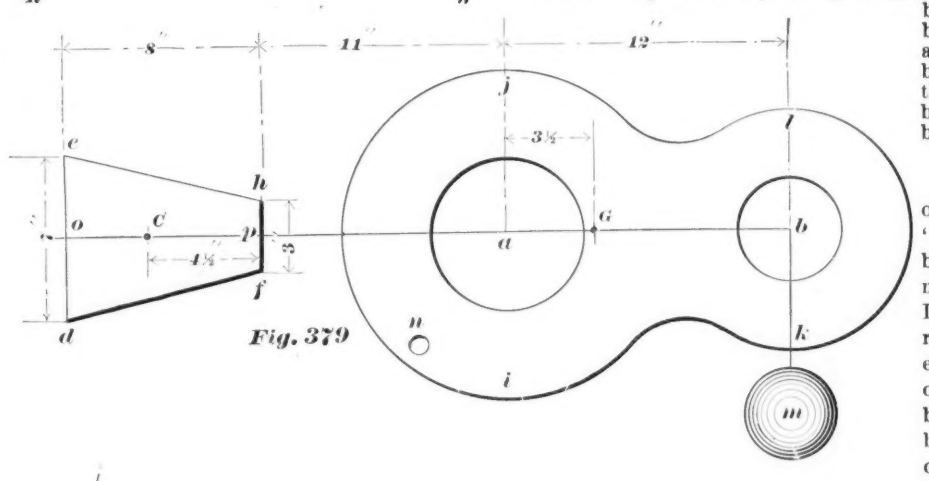


Fig. 379

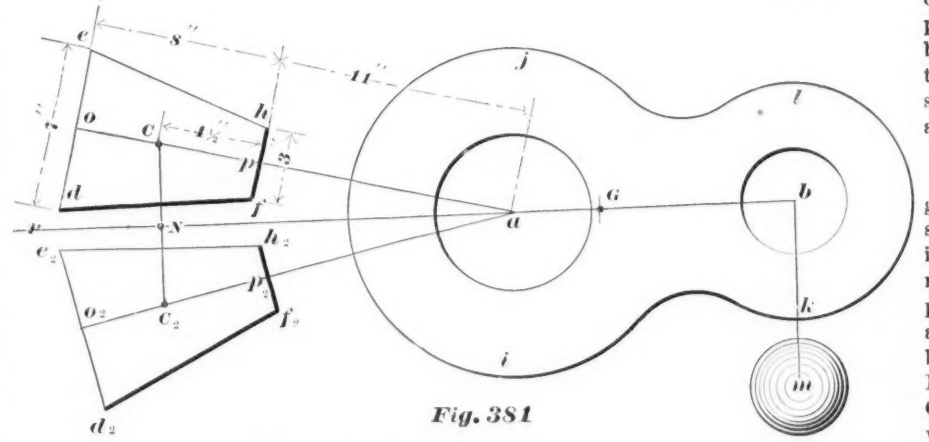


Fig. 381

MODERN LOCOMOTIVE CONSTRUCTION.

ter a. In fact, the only difference between this example and the former one is that two weights for counterbalancing, instead of one, are to be used. It is required to find the number of pounds in these weights and their thickness.

Since the size and weight of the crank, and also the additional weight m, are the same as before, it follows that the total weight considered to be applied to the crank pin will be 172.91 pounds, and this weight must be counterbalanced. Again, since the size of each counterbalance weight, except the thickness, is equal to the size of the weight shown in Fig. 379, it follows that the center of gravity C of the upper weight must be in the same relative position as before, that is, the distance between the center of gravity C and the edge $f\,h$ must be equal to $4\frac{1}{2}$ inches. The same remarks apply to the center of gravity C_2 of the lower weight. Consequently, the distance between the centers C and a will be equal to $15\frac{1}{2}$ inches, and the distance between the center C_2 and a will also be equal to $15\frac{1}{2}$ inches, both distances remaining the same as in the previous example.

We may now consider the weight $e\,d\,f\,h$, and the weight $e_2\,d_2\,f_2\,h_2$ to be segments of one counterweight. Now, considering these two weights to form one counterweight, $e\,d_2\,f_2\,h$, it must be apparent that neither the consists in the length of the lever arm $c\,a$, which in the previous problem was $15\frac{1}{2}$ inches long instead of 15 inches, as we must now consider it to be.

Remembering that the new center of gravity N is the common center of gravity of the two segments, and is the only center of gravity that can now enter in our calculation, we can find the sum of the weights of the segments by Rule 41. Hence we have

$$\frac{172.91 \text{ pounds} \times 12 \text{ inches}}{15 \text{ pounds}} = 138.36 \text{ pounds,}$$

which is the sum of the weights of the two segments. Consequently the weight of one segment will be

$$\frac{138.36}{2} = 69.16 \text{ pounds.}$$

It will be noticed that in this example the sum of the weights of the two segments is somewhat greater than the weight of the counterbalance used in Fig. 379, and yet in both examples the weights applied to the crank pin, which were to be counterbalanced, are equal. This is as it should be, because in Fig. 381 the distance between the center of gravity N and the center a of the axle is less than that between C and a in Fig. 379.

We have found that the weight of one segment of the counterbalance in Fig. 381 is equal to 69.16 pounds. In order to find the thickness of one of these segments of the counterbalance we must first find by Rule 42 the number of cubic inches contained in each segment.

Hence we have

$$\frac{69.16}{.26} = 266 \text{ cubic inches.}$$

Now, since we know the area of the face $e\,d\,f\,h$ of one segment is equal to 40 square inches, the thickness of the segment will be, according to Rule 43, equal to

$$\frac{266 \text{ cubic inches}}{40 \text{ square inches area}} = 6.65 \text{ inches.}$$

Regarding the bill before the Maryland Legislature to repeal the act incorporating the Baltimore and Ohio Railroad Relief Association, *The National Car and Locomotive Builder* says:

> The railroad company contributed $100,000 as the nucleus of a fund for the association in 1882, and the employes are required to pay a certain percentage of their monthly earnings into the treasury. The opponents of the association contend that in case of discharge from the road a member gets nothing for his monthly contributions, however long he may have been a contributor; that, in case of a reduction in force, he may be turned adrift for no fault of his own; that in case he is dropped before reaching the age of 65 years, he has no chance of being pensioned; that the road obtains, by means of the association, so strong a hold on its men that they dare not rebel against any reduction of wages, as they would lose all chance of securing benefits for which they have perhaps been taxed for years.

The Locomotive concludes its summary of boiler explosions for 1887 by saying: "Nearly 37 per cent. of the whole number of explosions were, as usual, furnished by the lively saw-mill boiler." Less than one year ago our contemporary took us to task for claiming that explosions of locomotive boilers were comparatively rare, putting the safety, by implication, in favor of saw-mill boilers. According to our contemporary only fourteen locomotive boilers exploded during the year 1887, which number is less than eight per cent. of the total explosions. Does our contemporary still think as it did less than one year ago?

The United States Government is engaged in an operation of exceedingly small magnitude, the object of which is to cancel a patent for a process for making sugar from sorghum. The patent was granted to Magnus Swenson, and it is not pretended that it does not bring about important results. But Mr. Swenson was in the employ of the Government when he made his invention, hence it is concluded that he has no rights that ordinary mortals are bound to respect. When Government officials get after an inventor his chances are slim. It would have been fortunate for Mr. Swenson if he had been, at the time of his invention, working for anybody rather than the United States Government.

The real value of fire insurance is in the fact that insurance companies exact certain precautions that tend to prevent fires. But such is the perversity of human nature, that, unless obliged to take these precautions by statute, so to speak, men will not take them.

The *Chemical Journal*, of Nuremburg, relates a case in which all the workmen in the melting department of a factory were made sick from the mercury in tin. The tin used was found to contain nearly $1\frac{1}{2}$ per cent. of quicksilver.

Engineering says that the government of New South Wales has accepted the bid of an Australian builder for fifty locomotives at $6\frac{1}{2}$ per cent. above the cost of English engines landed in the colony.

The Springfield (Mass.) Foundry Company, in a circular, remind their workmen "that the average loss on a bad casting is from five to seven times the profit on a good one."

Practical Details of Blacksmithing.

RAMRODS AND SPINDLES AT THE TRIP-HAMMER.

BY B. F. SPALDING.

This paper gives two methods of straightening and truing small rounded steel work in tools separate from the drawing dies.

Muskets were in use nearly a century before this country was discovered. The charges were rammed down with wooden ramrods. It was considered a great step in warfare when, under Napoleon Bonaparte, iron ramrods were substituted for those of wood. The objection made to iron, which did not at that time seem fanciful, was that it was liable to strike fire and ignite the cartridge in driving it home. But daring investigators decided that this objection was more in the mind than in the matter. It was decided that it was not substantial, and iron prevailed. But even iron could be improved upon. The rods bent easily. Then the rods were made lighter, and of steel, to which was welded a soft iron head. Soon after the advent of the Springfield rifle, the iron head was abandoned, and the finely tempered steel ramrod, of the government pattern, which was used during the civil war, was adopted. Three-quarters of a century have improved this article, from being a rude affair, to being an exhibit of fine workmanship. Another quarter of a century, and further improvements may have ended its existence.

A good ramrod is really a work of art in design, and of wonderful skill in manufacture. The stock for each one is carefully weighed and cut from the bar. The head and the swell beneath it are then blocked out under the trip-hammer, and the long, slim, tapering rod is then drawn out with a pair of dies, which for the most part are nearly flat, under the trip-hammer, which strikes about 400 blows per minute. There is no cessation of the stroke, for the heater has a hot one ready to be worked on as soon as the one which is being worked is finished. The hammer strikes the last blow on the finished one, and the next blow strikes the hot one. With a hammer running at this speed, the celerity, the accuracy, and the judgment exercised are elements of a skill than which I know no greater.

After the rods are drawn down square, they might be finished by rounding with a common pair of rounding and straightening dies, keyed in in the usual manner; but the length is so great as to make it hazardous in practice, and other means have been adopted. These appear in the form of jumper dies, used under the trip-hammer, and, as being of considerable value for use on other articles, they merit description.

The jumper box, in which the dies are to be inserted, will not be too good if it is made of the best iron that can be procured. The iron should be of a width corresponding to the height of the box, which is determined by the height of the dies generally used in the hammer. If the height of the two dies together is 5″ exclusive of the tenons, the width of the iron should be about 4″. It should be ½″ thick. If the die is to cover a space on the rod 5″ in length, and is to be ¾″ thick, the hole in the box must be of the same dimensions. In getting the length of stock required for a box of this size, actual measurement would give for the two sides 5″ × 2 = 10″; the two ends ¾″ × 2 = 1½″, and the four corners, ½″ × 4 = 2″, making 13½″. (See Fig. 1.) This amount would be insufficient. The best way to make these boxes is to weld up a ring and then flat it enough to admit a pin of the size which the hole is to be, and then hammer it to fit the pin. It is a very easy matter to make a hole of this kind smaller, but it is a very difficult matter to make it larger. If it is hammered in any direction it will become smaller; but to make it larger requires a vast amount of stretching and working. It is therefore best to take plenty of length. In this case the calculation could safely be made to flat the hole down to 1″ after welding the ring, and have it then 5″ long, besides being, beyond this, half round at each end.

These two half rounds, or half rings, would make or be equal to a full ring 2″ in outside diameter, and 1″ in diameter of hole, the mean of these two diameters being 1½″, or once the thickness of the iron, added to the diameter of the hole. The circumference of this would be 4¾″. In flatting the ring down it would upset at least 1¼″, and allowing half the thickness of the iron to be taken up in welding, would be another 1¼″. Adding the two sides, 10″, to 4¾″ and ¾″ would make 15¼″. This is, ¾″ more than the finished box will give in actual measurement. The extra stock will be taken up by wastage in the fire, or will be trimmed off at the ends in squaring it up. This jumper box (see Fig. 3) is so shaped as to key into the trip-hammer die block or anvil. The figure shows one side torn out, through which can be seen the dies. A ¾″ hole is made in each end, 1½″ from the bottom. The lower die is of the same height.

The hole or impression, which is to be used in giving a round shape to the ramrod, is made half in each die, and will be central with the hole in the box. The box, being 4″ high, and the depth of the tenon 1¼″, the box will be 2¾″ clear of the tenon, which sum, taken from 5″, the height of the dies

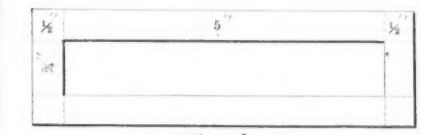


Fig. 1

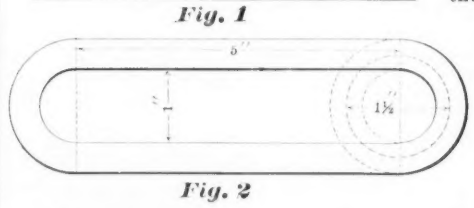


Fig. 2

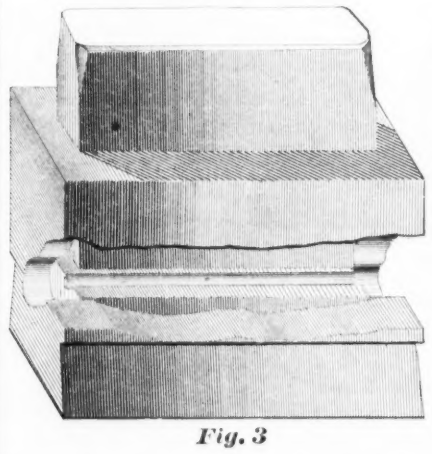


Fig. 3

generally used, will leave 2¼″ to be taken up, 1¼″ of it by the extension of the top jumper die above the box, and 1″ by the slight extension required of the upper trip-hammer die, below the tenon. The object of taking up about the same space as a pair of common dies, is to avoid trouble in re-adjusting the hammer every time a change of dies is made. The use of the jumper box is simply as a guide for the dies, and the arrangement allows the weight of the upper die always to ride on the rod which is being rounded, and keep it from jumping out. This is essential, because the least nick in the side of the finished ramrod will cause it to be condemned; for every rod is ground to accurate measurements. The day has passed by when a variation of a sixteenth of an inch is allowed in interchangeable work, even where as much variation would do no harm.

If the gate is left open a little for the calf, it will soon be pushed open wide enough for the cow, and then the whole herd will get through. At the watch factories the measurements are in millionths, and at the gun factories and other shops, where close work is done, they are taken in the inflexible rigidity of a steel gauge.

The exact duplication of parts was practiced before the first clumsy efforts were made to introduce the system into the manufacture of guns. Arkwright erected his first spinning frame in 1769, which went by horse-power, but in 1771 he made one to go by water-power. Hargrave had made spinning jennies previous to 1768, and these must have had spindles which, on each machine, must have been uniform with each other. Spinning jennies were made in this country probably before 1780, for there were heavy penalties to be paid for taking them out of England—so jealous was our mother—and yet they were in use in Worcester, Mass., in that year. Hugh Orr made some at Bridgewater in 1786. Now this Hugh Orr was a very ingenious and enterprising mechanic. He made the first trip-hammer in this country by some accounts, and used it in the manufacture of scythes and hoes long previous to this time, as Asa and Andrus Waters had used these tools in Milbury during the revolutionary war. It is reasonable to suppose that when a demand arose for things that could be made so easily with the trip-hammer as spindles can, they would be made with this tool from the start. It was necessary that the spindles should be uniform in size, in order that the bobbins might fit them, and this result was probably attained then, as it is now, by forging them under the trip-hammer and revolving them on their own axis, in contact with a revolving grindstone, to grind them round, and to a regular size.

As the spindles are slightly tapering, very fine measurements were got by the steel gauge, which, if the spindles were ground but little too small, would slip up on them much further than was allowable. I do not know that the jumper box was ever used in edging them, although there are the same objections, if not greater, to their being marked in the dies that there are in the case of the ramrods. They are less liable to be marked, as they are shorter. It was the necessity for accurate trip-hammer work on spindles that caused the substitution of three different patterns of cast-iron framed hammers—the Lawrence, Chicopee, and Holyoke patterns—to take the place of the older style of wooden framed hammers.

The stock for shuttle spindles is cut off to the right length to make two spindles. These may be made of ⅜″ round steel. They may be flat ⅜″ × 5/16″ for 21″, then rounded to 5/16″, and tapered for 6″ down to the end, which is, say, 3/16″ in diameter. The first operation is to put them under the "break-down" die of a quick running hammer, and with a rapid movement draw them roughly out. The die has four impressions cut across its face—the "break-down," the "point," the "middle," and the "butt." The hot spindle is worked in these successively, the hammer keeping its pace without hesitation or waiting for hot iron. The heater has the hot iron at hand as soon as the preceding one is finished. After both ends of the spindle stock are drawn out for the whole lot which is intended to be put through at a time, a pair of dies are fastened in the hammer, which are about 8″ long. Into these is cut an impression of the shape which the spindle is to be made, taking in as much as 1½ inches of the large part, in order to true up the shoulder. A very small stream of water is allowed to run on the die, and the hammer is again set in motion. The drawing of the spindles has already made them very nearly of the proper size, but these dies match the joints of the shorter dies, and the spindle comes out from them very smooth, straight, and round. It is quite a trick to work them in under this long die, until they are up to the shoulder, and keep them turning bedded in it, until the sound of the hammer indicates to the practiced ear that they are down just right, to size, and then to take them out with a side motion as the hammer rises, and to go on again and perform these operations continuously without a miss or break. When both ends are straightened the stock is cut in the middle. The large ends of the spindles are then flattened and cut off, and the forging is completed by trimming off the tips. To do the straightening in the long dies without marring the work, the hammer must run very rigid and tight.

At Buffalo there are 44 elevators of one kind and another. Last year 23 of them did not handle a bushel of grain. Twenty-one elevators handled over 58,000,000 bushels of grain. It must not be inferred that the 23 houses that did not handle any grain did not, on that account, make any money. Their owners realized handsomely on their investments. Furthermore, the pool that runs things at Buffalo could have locked up ten more houses and still have done all the work. The pool scooped in over $1,000,000 on last year's grain trade. That is a pretty big toll to pay for mere transfer business. Buffalo is one of the future great cities of the world. Not even her elevator ring can block her way, but it does drag her skirts in the mud most awfully.—*American Miller.*

Notes on the Expansion of Steam.

BY RICHARD H. BUEL.

In elementary treatises on the steam engine, the subject of the expansion of steam is ordinarily treated in what may be entitled an ideal manner; that is to say, it is supposed that the expansion takes place under conditions which it is impossible to realize in practice. More than this, the computation of the thoretical gain due to expansion, as ordinarily made, is more favorable to expansion than should be the case. These points are well illustrated by the following table, which is a fair specimen of the manner commonly adopted in discussing the question. In this table it is supposed that expansion takes place in a cylinder having a diameter of 16 inches, and a stroke of 24 inches, and that the mean absolute pressure is to be 70 pounds per square inch in every instance.

RESULTS OF USING STEAM EXPANSIVELY

Period of admission or point of cut-off.	Initial pressure of steam, lbs. per square inch.	Total heat of steam used, in units.	Percentage of saving compared with full stroke.
Full stroke.....	70.	527.	
18″=¾ of stroke	72.5	408.7	22½
12″=½ " "	82.7	309.5	41¾
8″=⅓ " "	100.0	247.5	53
6″=¼ " "	117.4	215.9	58
4″=1-6 " "	150.5	186.5	64½
3″=⅛ " "	181.8	165.8	68½
2″=1-12″ "	241.4	144.8	72½

It is usually explained that the theoretical gain represented by a table similar to the above cannot be realized in practice, owing to losses of heat by radiation, conduction, etc., and that in order to make practice conform as near as may be with theory, the steam pipes, boiler and cylinder should be protected by non-conductors against losses of heat.

Theories of this kind are very misleading. It may be stated, generally, that any theory which is flatly contradicted by practice has outlived its usefulness. In this particular case it may be of interest to show that, even disregarding the losses of heat from radiation, conduction, etc., the theoretical gain from expansion is very different from the saving represented in the foregoing table, and that, when the losses of heat are considered, a theoretical investigation will give figures closely approximating practical results. And this is as it should be. Theory and practice are never antagonistic, unless the theory is untrue by reason of ignoring some of the essential conditions of a problem. Every practical engineer knows that in a single cylinder engine, at ordinary pressures, a very early cut-off is productive of wasteful results. An instance of this principle may be appreciated. In a certain newspaper and job printing office, a large automatic cut-off engine was used for the newspaper presses, and was also employed at a greatly reduced power, for the job presses alone. The agent of another automatic cut-off engine, after taking some indicator diagrams from the large engine when driving the job presses, and observing that the admission line was scarcely perceptible, offered to put in a small engine for the job work, under a guarantee of saving 1,000 pounds of coal a day. The proposition was

accepted, but the new engine, being run at high speed, had a very early cut-off, and the coal consumption was increased. A change of pulleys was made, and the speed of the small engine was reduced sufficiently to give a cut-off at about one-fourth of the stroke—with the result of saving nearly 1,200 pounds of coal per day over the original consumption.

Now, theory ought to indicate such a result, and it will, if it is a true theory.

Disregarding, for the present, the losses due to radiation, conduction, etc., it may be said that the theory to which reference was made above is defective in three important particulars:

1st.—In the method of comparison.

2d.—In the neglect to consider the effect of back pressure.

3d.—In the neglect to consider the effect of clearance.

As to the method of comparison, it may be remarked that it is unfair to give the short cut-off the benefit of increased steam pressure, and that the proper plan is to give each case the same initial pressure, and increase the dimensions of the cylinder, as required for the different points of cut-off. Certainly, if there is any benefit in high pressure, all the cases should fare alike.

The size of a cylinder may be increased by changing the diameter or the stroke, or both. For the present comparison it will be convenient to maintain the stroke constant, and increase the diameter as required, on change of cut-off—bearing in mind that a comparison is to be made of different rates of expansion, from the same initial pressure, the power exerted to be the same in every case. (On some accounts, as will be explained hereafter, it is often desirable to change both diameter and stroke, but these changes will be made, when necessary, and do not affect the discussion at the present stage.)

The following table gives the results of such a comparison, using steam of 100 pounds' absolute pressure in each case, and supposing the steam to expand in an isothermal curve, according to the law of Mariotte:

THEORETICAL RESULTS OF USING STEAM EXPANSIVELY. — UNCORRECTED FOR BACK PRESSURE AND CLEARANCE.

Point of Cut-off.	Mean total pressure pounds per square inch.	Relative area of Cylinders	Relative amounts of steam used.	Per cent. of saving.
1	2	3	4	5
1	100.0	1.00	1.000	
¾	96.4	1.04	.780	22.0
⅔	84.7	1.18	.590	41.0
½	70.0	1.43	.477	52.3
¼	59.7	1.68	.420	58.0
1-6	46.5	2.15	.358	64.2
⅛	38.5	2.60	.325	67.5
1-12	29.0	3.45	.288	71.2

The figures in column 2 of the foregoing table are calculated by adding 1 to the hyperbolic logarithm of the ratio of expansion (the reciprocal of the corresponding cut-off in column 1), and dividing the sum by the ratio of expansion. The figures in column 3 are the quotients of 100 divided by the numbers in column 2. The figures in column 4 are the products of the numbers in column 3 multiplied by the corresponding numbers in column 1. The figures in column 5 are the differences between 1 and the numbers in column 4, multiplied by 100. As before, there is an apparent increase of economy every time that the cut-off is shortened, but this is because the modifying effects of back pressure and clearance have been neglected.

In considering back pressure, it seems proper to include all prejudicial resistances, so as to obtain the effective pressure on the piston, or the pressure which is available for useful work. In the case of a non-condensing engine there is the constant back pressure of the atmosphere, averaging 14.7 pounds per square inch—and it will be a moderate estimate to consider that the additional back pressure due to ports, together with the friction of the piston, crosshead, pins, etc., is 2.8 pounds per square inch—making 17.5 pounds to be subtracted from the mean total pressure in each case. The effect of this correction is shown in the next table, the mean pressures being obtained by subtracting 17.5 from each mean pressure of the preceding table, and the other columns being calculated in a similar manner to that already explained.

THEORETICAL RESULTS OF USING STEAM EXPANSIVELY. — CORRECTED FOR BACK PRESSURE, UNCORRECTED FOR CLEARANCE.

Point of Cut-off.	Mean Effective Pressure Pounds per square inch.	Rel a'e Mean Pres're	Rela've Area of Cylinders.	Rela've Am'ts of Steam Used.	Perc'ge of Saving.
1	2	3	4	5	6
1	82.5	1.000	1.00	1.000	
¾	78.9	.959	1.04	.780	22.0
⅔	67.2	.815	1.23	.615	38.5
½	52.5	.636	1.57	.523	47.7
⅓	42.2	.512	1.95	.488	51.2
1-6	29.0	.352	2.84	.473	52.7
⅛	21.0	.255	3.92	.490	51.0
1-12	11.5	.140	7.15	.596	40.4

From this table it appears that, under the assumed conditions of initial and back pressure, the most economical point of cut-off, theoretically, is about one-sixth of the stroke, since the saving is decreased, whether the cut-off is lengthened or shortened, from this point. The conditions assumed are such as accord well with modern practice—100 pounds' absolute initial pressure, about 85 pounds by steam gauge being very common; and the back pressure assumed being, if anything, too small to represent average practice, rather than too large. By changing the initial or back pressure to suit a condensing engine, for example, different results will be obtained, but the present table is sufficient to show the mode of application for any given data, and to illustrate the fallacy of such comparisons as are made in the table given at the commencement of this article.

Such tables were published in early treatises on the steam engine, and like all errors which die hard, will probably reappear from time to time. It is just such false discussions which array the practical man against the theorist, when there should be no contest, for true science makes theories from the facts determined by practice.

So far, the theoretical results of expansion have only been corrected for back pressure. Other corrections are necessary in order to ascertain the true theory, and clearance will be next considered.

High Speed Gearing.

During the last few years, and particularly since the adoption of double-helical teeth, a great increase has been made in the speed at which heavy gearing is run, and in many cases there are now successfully adopted, speeds which, in former days, would have been regarded as utterly impracticable. The most striking instances of this which we have come across is in the case of a pair of double-helical wheels at the works of Messrs. R. Johnson & Nephew, the well-known wire-drawers of Manchester. These wheels, which were cast by Messrs. Sharples & Co., of Ramsbottom, Lancashire, are 12 in. wide on the face by 6 ft. 3 in. in diameter, and they have now been running for over a year at 220 revolutions per minute, the pitch line speed being thus 4,319 ft. per minute. Notwithstanding this enormous speed the wheels run with scarcely any noise, and their working has been most satisfactory. This is the highest speed we have heard of for geared wheels running iron to iron, and the fact that it has been adopted with success is a most interesting one.—*Engineering.*

Several of our English contemporaries take note, as if of something new, of the work of an Italian engineer in jacketing a steam engine cylinder with steam of higher pressure than that used inside the cylinder. We were under the impression that this practice was frequent in England. In this country it is often done. We have known of more than one instance in which it has been put in use with considerable flourish, and thrown out of service when it came to a test of the performance of the engines.

It has, for some years, been considered that one unit of heat was equivalent to 772 foot pounds of work. Lately this has been disputed, but no one seems to have given any satisfactory reason for doing so. Some scientific writers are sure that the equivalent should be changed, but until they can give better reasons for their faith it is safe to adhere to Joule's equivalent.

LETTERS FROM PRACTICAL MEN.

Setting Lathes to Turn Straight.

Editor American Machinist:

There is a very simple tool in use in the shop that we are employed in, which might assist C. L.

The enclosed outline sketch shows its construction, and will probably need little explanation. It is fastened into the tool post, and the pointed piece of steel which is hinged upon the rivet is moved up and down and adjusted by the cross feed screw until it just comes in contact with a place turned upon one end of a shaft; then the shaft is reversed and the carriage moved up to the other center, and the test repeated. In this way lathes can be set in line, or taper work can be set. The lathe hands here are quite "taken up" with its simplicity and usefulness.

Having received so much valuable information through the AMERICAN MACHINIST, we contribute this little "kink," hoping it may prove useful to some of your readers, and thus be a partial return for what we have received. B. AND F.

Making Open Sand Rings.

Editor American Machinist:

The accompanying sketch represents a plan for moulding various jobs, such as open sand rings or others requiring to be

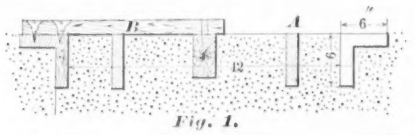


Fig. 1.

Fig. 2.

covered with copes. Fig. 1 shows a sectional view of making an angle iron from segment, Fig. 2.

The general way of making such a mould as here shown is to level up a bed with straight-edges, and to work from a sand joint. Instead of doing this we use a pulley rim pattern, *A*, upon which to guide the segment arm *B;* the pulley rim is also used for making a level parting for jobs requiring copes, which is done with a straight-edge. We have found this method of making small level beds very handy on account of the celerity with which they can be made.

GEO. O. VAIR.

Preventing Chattering.

Editor American Machinist:

Referring to Jarno's Shop Notes, No. 2, in regard to the prevention of chattering, I have seen the same results produced by turning the tool upside down, and running the lathe forward, the tool being placed on the opposite side of the center. In this case there will be no tendency to unscrew the face plate, but it will not admit of the tool being fed far beyond the center, as lathes are ordinarily constructed. In the instance that came under my observation, the workman was turning out a hole in a casting fastened to the face plate of the lathe.

W. S. LEONARD.

There Might Have Been a Mysterious Explosion.

Editor American Machinist:

If my memory serves me right, I have seen somewhere the question asked whether a boiler would blow up full of water. The following will illustrate the case where a good, strong boiler full of water (to all appearances) might have gone to pieces with a very low pressure, and is a warning, by the way, to those who place implicit confidence in glass water gauges.

There is a battery of three return tubular boilers that furnishes the steam for a planing mill, in this city. Last Saturday evening the engineer, as was his custom, shut down with a good height of water in the boilers.

Monday morning, when the fires were started and had been burning a while, he noticed a dead level of water in the glass gauge. There was an indication of plenty there, but it did not rise and fall as usual. Thereupon he went to operate the small cocks that connect the boiler and gauge, and found them closed. He opened them, when, lo! the water went and steam issued forth. No water in the boilers.

The fires were hauled, an investigation held, which developed the fact that some one, criminally bent, and knowing well the consequences of the above, had introduced himself during Sunday night and played that game. A. F. DELBERT.

Trouble with Piston Packing, and the Remedy.

Editor American Machinist:

I noticed in a late issue of your paper an inquiry as to the best packing in the long-stroke cylinder, to prevent the wearing of the bottom part of the cylinder.

I am running in the Peerless Roller Flour Mill of this city a Cummer engine, cylinder 16×36, 100 revolutions per minute.

The three first years it ran the piston head wore out the bottom of cylinder so much more than the top or sides that it had to be bored out twice, and three different packing rings tried, with the same results. At last we extended and ran the piston rod through the loose head, so it now has an equal bearing each end of cylinder. The result is a great saving of oil, engine ran thirteen months, day and night, without visible wearing of cylinder, and without renewing packing.

CHRISTOPHER DANHEISER.

Mt. Vernon, Ind.

Hardening Cast-Iron—Chattering Tools—Tool Rooms.

Editor American Machinist:

Hardening cast-iron is very easily done. For instance: I had occasion to produce a lot of small cast-iron ratchets with teeth cut instead of cast. The extreme points of the teeth were so weak and brittle as to stand no shock at all; the pawl working over the teeth would break them off. So I cut the teeth and then heat the ratchet red, and covered the teeth with potash, and after it became dissolved by heat dipped it in water not too cold; the result was a tooth at once hard and strong. Care must be taken in heating, lest unequal expansion break the piece. Cast-iron can be used thus in many places instead of steel, or case-hardened wrought iron.

Chattering in a lathe is nearly always caused by improper tools. I have seen false cylinder heads, ¼ inch thick, 30 inches diameter, that it was thought impossible to turn and polish without chatter marks. All sorts of contrivances were tried to no effect, and finally, when done, the blame, which had been attached to the tool, was discovered to be in the man. Proper tools, properly manipulated, will prevent chatter, and the lathe, or other tool, can run the right way, too.

I am glad the subject of the tool room has come up again. It is a subject of greater importance than proprietors (without them) generally understand. The mechanic traveling can see at once on entering a place whether they have a tool room or not. If not he will see twist drills, reamers, boring bars, chucks, files, etc., etc., lying around under machines, under foot, and left where the last man used them, a constant eyesore and a bill of expense replacing lost and broken tools, and no tool in shape to be used when wanted, and never to be found when wanted. If there is a tool-room, then nothing of the kind is seen, and in lieu thereof

is a neat room, a tidy appearance in the shop, a noticeable absence of broken drills, chewed-up drill shanks, milling cutters all broken up, and no tap-wrenches lying around.

The greatest help of a tool room is in the increased efficiency of men who, by using good and well-kept tools, are enabled to turn out good and perfect work. Work done with good tools is done quicker and better than work done with poor tools, and there is no "temper" mixed up with it.

In addition to Mr. Miller's ideas, I would like to add that all tools taken from the tool room during the day should be returned at night if possible, as, if not, and the man fails to come next day, then it is necessary to hunt up the tools and return them, and may be in the meantime some one borrows it and says nothing, and confusion results.

C. A. B.

Grinding Attachment.

Editor American Machinist:

I send you sketches of a grinding attachment for lathes, which I devised about ten years ago, and have used for some years with entire satisfaction.

It consists of an emery wheel (Fig. 1) mounted on a slide rest (also shown in Fig. 1), and two brackets (Figs. 3 and 4), which are to be clamped to the shears of any lathe.

A glance at Fig. 2, which is a plan view, will explain the arrangement of the pulleys and belts. The flat belt receives its motion from the cone pulley of the lathe to which it is attached, and thence transmits the motion to the emery wheel by means of the round belt which runs in grooved pulleys.

The bracket (Fig. 3) is to be clamped to the shears of the lathe opposite the largest step on the cone pulley, and can be adjusted vertically to correspond with the height of the lathe spindle, and horizontally to give the required tension to the flat belt. This arrangement makes it possible to use the same belt on nearly all sizes of lathes.

The bracket (Fig. 4) is also clamped on the shears of the lathe, but to the right of the tail block. The pulley shown thereon is intended to guide and also to give the required tension to the round belt that drives the emery wheel. A constant tension is maintained on this belt by means of a spring enclosed in a box between the clamp and the pulley.

The clamps shown in Figs. 3 and 4 are adjustable to suit every design and thickness of shears.

The two guide pulleys, shown in Fig. 1, are adjustable horizontally by means of a slide bar and a small movable bracket to bring them in line with the pulleys on Figs. 3 and 4, and will generally come in line with the shears of the lathe.

The slide rest, upon which the emery wheel is mounted, is made to swing round to any angle, the same as a compound rest, for grinding centers, taper holes and such work, the hand wheel shown at the right being used for the feed.

This attachment has been in practical use for some time, is easy to make, and can be used for either internal or external grinding, taper or parallel, and works very satisfactorily. It is not patented, and will not be, as I have decided to present it to the readers of the American Machinist, to whom I can recommend it as giving the best results of any grinding attachment I have seen, as its use is almost universal and it can be attached to any lathe in a few minutes. In Fig. 1 it is shown with two emery wheels on, but in practice only one is used.

John T. Usher.

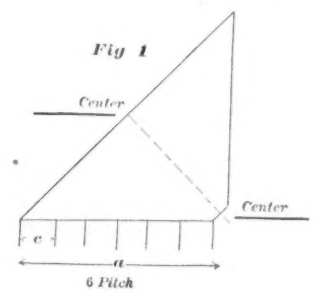
Cutting Threads with Taper Attachment.

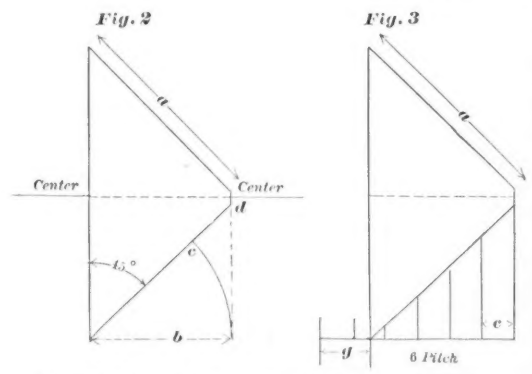
Editor American Machinist:

In the American Machinist of Feb. 4th, a correspondent asks whether it is possible to cut a thread of a correct pitch on a tapering piece in the lathe, with the use of the taper attachment, the centers being set as for straight work. Your answer to him was, "yes."

Looking at the question from my point of view, I do not think a thread of a correct pitch can be cut with the taper attachment, for the following reason, and we will carry the illustration to an extreme, so as to magnify the existing errors.

In Fig. 1 we have a piece of conical work on the centers, with the tail stock set over. The lathe is geared to cut six threads per inch, and the distance a measures one inch. When the tool has traversed the distance a it will have cut six threads of a correct pitch; that is, correct enough for our practice. Here c equals the pitch, equals one-sixth of an inch. We will say it takes one minute for the tool to traverse the distance a.





Cutting Threads with Taper Attachment.

In Fig. 2 we have the same example as in Fig. 1, with the centers set straight. When the tool has traversed the distance b, it has also traversed the distance a, and a being longer than b, it will cut six threads of an improper pitch, the amount of error being equal to $c\,d$. It will also be seen that it will not take one minute to traverse the distance b, as it did the distance a in Fig. 1.

In Fig. 3, by dropping perpendicular lines, we will see how many threads we get in the distance a; also that the pitch c' is not equal to the pitch c in Fig. 1. The distance g, Fig. 3, is equal to the distance $c\,d$, Fig. 2.

Edward D. Gleason.

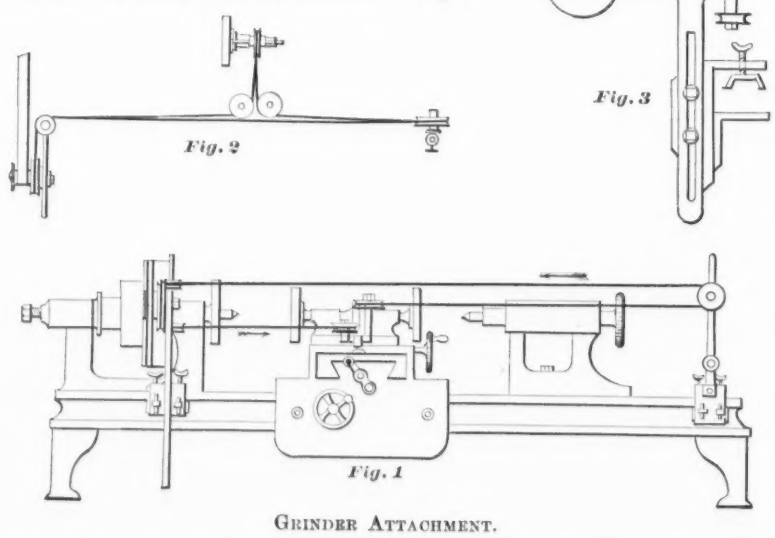
[An article suggested by the above communication will be found in the present issue.]

Air Pump Difficulty.

Editor American Machinist:

I do not know that I can give C. A. G. any light on his air pump difficulty, which he must be in the air piston rings not fitting the cylinder, his water test notwithstanding. I have had the same trouble with air pumps, and have taken out the air piston and found that the rings touched in spots. Then I would dress off the spots, make them fit the the cylinder a little better, and in a short time they would wear to a bearing and the pump would work better. But notwithstanding all this, if there is any leakage between the pump and resevoirs the pump is liable to act as C. A. G. speaks of.

W. F. R.



Grinder Attachment.

The Pitch of Taper Taps.

By Fred J. Miller.

On this page is a communication relating to taps, which raises a question often discussed among mechanics, and which is of interest to those who have taper taps to make. The arguments there presented are all right, if the pitch of a taper screw may properly be measured on a line parallel with the sides of the cone; but I do not think that is the proper way to measure it, but that it should be measured on a line parallel to the center line of the screw.

If we consider the case of a straight or cylindrical screw, its pitch may be defined in two ways. We may say that the pitch is equal to the distance from the center of one thread to the center of the next, or, we may say it is that distance which the screw will advance in the direction of its axis when turned exactly one revolution in a threaded hole into which it is fitted.

In the case of single-threaded screws it is evident that these definitions are both correct, and that each is equivalent to the other. But if applied to taper screws they conflict (as is clearly shown by Mr. Gleason's diagrams), unless the distance from thread to thread is measured upon a line parallel to the center line of the screw; and it is only by so measuring, or accepting the second definition, that confusion can be avoided.

Taps are frequently made having part of the thread at the end cut taper and the rest straight. If such a tap were cut by setting the center over for the taper part, the pitch of that part would not agree with that of the straight portion, but if cut with the taper attachment the pitch of the two portions will agree, if measured on a line parallel with the center, and they will also agree when the tap is used, one part having no tendency to crowd through faster than the other.

From these considerations, and others which might be mentioned, it is evident that it is better to take the second of the above definitions as the correct one; it applies to all screws, whether straight or taper, and as a matter of fact the method pursued in determining the exact pitch of screws, where the greatest possible accuracy is required, is in accordance with it. If this definition be accepted, then the measurement of the pitch must, of course, be done on a line parallel with the center line of the screw, or the measurement, the definition, and the practical results obtained in use will not agree.

There is another point in connection with the subject, which is not generally recognized, and that is that taper taps cut by setting the lathe center over and using a dog in the ordinary manner have what is known as a drunken thread, the reason being that the angular velocity of the work is not uniform, the amount of variation from a uniform rate depending upon the distance to which the live center projects beyond the face plate, and the angle at which the work is set in the lathe.

The diagram (Fig. 4) clearly shows this. The line $A\,B$ represents the face plate of a lathe the centers of which have been set over to the distance shown. The center line of the work $C\,D$ projected would intersect the face plate at the point b, which corresponds to point d in the vertical projection of the face plate.

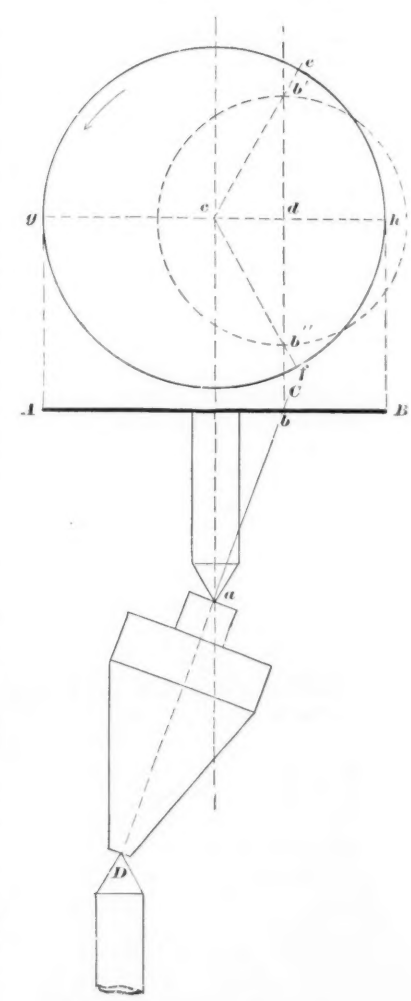


Fig. 4.—Pitch of Taper Taps.

Now, suppose the tail of the dog to be vertically over the center line of the work, it would be represented by the line $C\,a$, the vertical projection of which is at b'. It is evident that if the lathe be turned in the direction indicated by the arrow until the tail of the dog reaches the point b'', the work will have made just one-half a revolution, or 180°, while the lathe will have turned through the arc $e\,g\,f$, which is considerably more than 180°. Then during the other half of the revolution of the work from b'' to b', the lathe will turn through the arc $f\,h\,e$, which is less than 180°. In other words, while the lathe revolves about c as a center, the work revolves about d as a center, and we have the same essential conditions as are present in the Whitworth quick return motion, the principle of which was so clearly explained by Prof. Woods in our last issue.

In practice this effect is modified slightly by the fact that the tail of the dog and the face plate both have sensible thickness, a condition which, since it does not affect the principle involved, I have ignored, for the sake of simplicity.

The speed of the lathe being uniform, of course the travel of the lathe carriage is also

uniform; then if the speed of the work is not uniform, as we have shown, of course the result is a "drunken thread." During one-half the revolution of the work the tool is advanced a distance represented by the arc *e g f*, while during the other half of the revolution the tool is advanced through a distance represented by the arc *f h e*.

There is little doubt but that this is the real cause of much of the trouble and dissatisfaction experienced with taper taps cut in the oldway, the threads on one side of them having a tendency to crowd through faster than those on the other side, the difference between the two sides being equal to twice the maximum variation from the normal pitch of the screw—a condition of things which might reasonably be expected to make trouble.

The same thing is encountered in fluting taper reamers or doing other taper work in a milling machine in which the centers must be set out of line for taper work, and a device, one of the objects of which was to overcome that difficulty, was shown in an article by the writer, published in the American Machinist of April 18, 1885.

Many mechanics do not believe in backing off taps, or relieving them in the threads, and this belief, when carried into practice on taper taps, is also a source of trouble. For instance, suppose a tap to be of such a taper and pitch that the tap is .02″ larger in each succeeding thread, and that each "land" is one-eighth of the circumference of the tap, then it is evident that the back of the land is actually .0025″ higher than the front or cutting edge, and a good deal of friction might be expected unless the tap is relieved to that amount.

To Mould Bevel Wheels Without a Full Pattern.

By S. Bolland.

The spindle and center can be used to great advantage in the production of bevel wheels, but it requires more than ordinary care on the part of both pattern maker and moulder to make the plan a success. But if such care be exercised there is nothing to prevent as good work being made this way as can be got from the whole pattern.

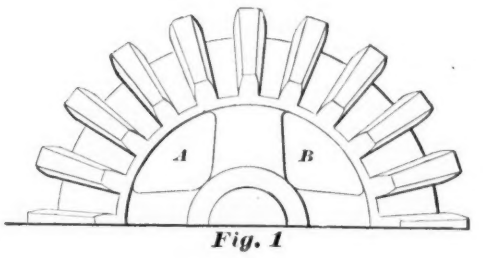


Fig. 1

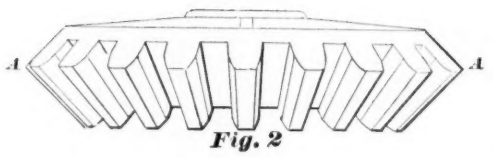


Fig. 2

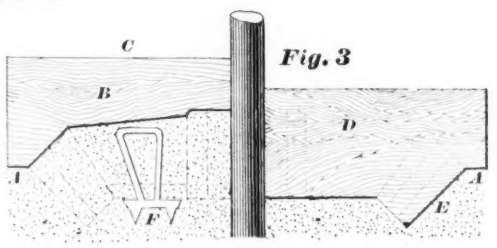


Fig. 3

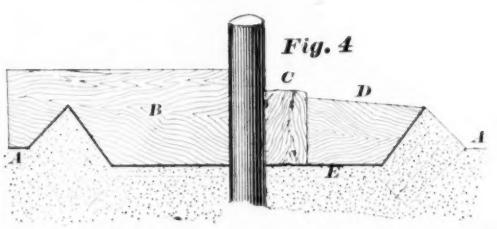


Fig. 4

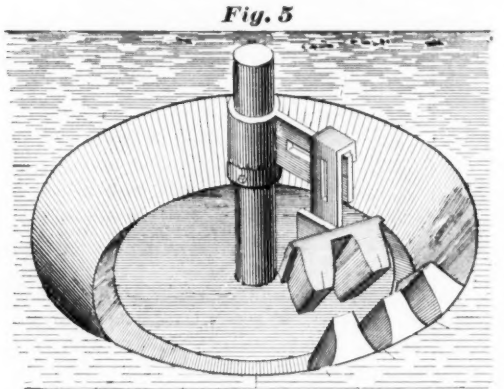


Fig. 5

Moulding Bevel Wheels.

I propose to show three methods of moulding a bevel wheel by the aid of the spindle, each of which has claims for precedence, according to the form of wheel desired. To illustrate this article I have chosen an ordinary coarse pitched wheel, about three feet in diameter, the plan and elevation of which is seen at Figs. 1 and 2. I do not purpose going into all the primary instructions for moulding such a wheel, as I take it for granted that any moulder who may be entrusted with this class of work will know what preparations are needed to insure a good casting; suffice it to say, that the center, when set down in the floor, must be low enough to allow of the point of tooth marked *A*, Fig. 2, coming level with the floor of the shop. Care is needed in setting down the center, as the spindle must be absolutely plumb before a start is made. I would also remind the moulder of the advisability of putting in a good cinder bed (the use of which will be seen presently).

As I intend these instructions to serve for castings other than wheels, I shall be particular to give the reasons "why," in all cases where it will be advantageous to do so. It has been suggested that *A*, Fig. 2, is the starting point or joint; all above this point must come into the cope, and necessarily, all below it will be in the floor. I speak now of the outer surfaces; the form of the wheel will determine what disposition we shall make of the inner surface, or arm cores; whether we shall lift them away on plates, use dry sand cores, or carry them in the cope. To better understand the several modes of procedure we will make our wheel by all the methods, beginning with the first mentioned, viz., lifting them away on plates. Fig. 3 will explain the matter. Point *A* corresponds with *A*, Fig. 2, and, as before stated, is the joint. *B* is a sweep attached to the spindle, and is intended to strike the exact form of the back of wheel; its edge is made to correspond with the top face of elevation, Fig. 2. This bed must be made hard and true, and in order to ensure accuracy let all the sweeps be made with the top edge *C* at exact right angles to the spindle, so that a square resting thereon, and brought up to the spindle, will test their correctness.

You now have a true model of the back of the wheel, which must be prepared for parting and the cope rammed over it. An important item is to stake the box well before lifting it away, and take such pains as will preserve them and the joint from injury, whilst the rest of the mould is being made. The portion of mould above *A* has been obtained by striking a model and taking its impression as you would from a pattern; but the position below *A* will be obtained direct from the sweep *D*. The lower edge of this sweep corresponds with all the surfaces below the point *A*. The broken lines seen on this figure represent a section of the wheel cut across the center, and will aid the understanding if carefully examined. I need not say that much precaution is needed in the preparation of this part of the mould, for accuracy as well as solidity.

In making this sweep it is well to have the surface *E* (which forms the bed for the teeth) made a little slack; this admits of the segment, with which the teeth are to be formed, being firmly set down in place. When the mould is swept mark off the arms and set on the core box; also put back sweep *B* and bring it into position at joint *A*. This will not only test the core box, but will sweep off the top of the cores exact with the impression taken in the cope. At *F*, Fig. 3, I have shown the lifting plate in position. By referring to Fig. 1, at *A* and *B*, it will be seen that quite a large plate can be used in this case, thus enabling the moulder to make a safe core. A method for securing these cores is shown in the American Machinist of Nov. 4, 1887.

When the wheel is large in diameter and very deep, this plan is the best, as the cores fit the places from whence they were taken with absolute certainty—something which cannot be said for dry sand cores in hardly any case. It must be remembered, also, that there is no shipping of cores in and out of the oven. Should this wheel be made with dry sand cores, the only deviation from the instructions given would be that, as soon as the bottom part of the mould was swept, the teeth could be proceeded with at once, and the cores placed to thickness after the mould was finished. In setting in dry sand cores it is well to have sweep *B*, Fig. 3, in position, so that they can be proved for depth, etc.

To carry the cores in the cope, it will be necessary to change the cope sweep, and, instead of a core box to form the arms and hub, these must be made as patterns, in the readiest way that suggests itself to the pattern maker. Fig. 4 will explain this method, as in Fig. 3 the broken lines show the lower surfaces of the mould; the point *A* is still the joint, but it will be observed that the bottom edge of sweep *B* follows the line of thickness down the rim and along the arm. When this has been swept out the hub and arm patterns can be set in position, as shown at *C* and *D*, Fig. 4. The ramming of this cope will not be as simple as in the former case, on account of the cores requiring to be secured to the cope by gaggers and chucks, or grates bedded on the bottom and bolted up before the cope is lifted. When lifted off, the mould can be proceeded with as directed for Fig. 3. In this case cores the thickness of the web *E*, Fig. 4, and in the form of spaces *A* and *B*, Fig. 1, must be set into place after the mould is finished. For all shallow wheels, large or small, this plan is the best.

We now come to the all-important part of wheel moulding, to wit, the teeth; and before entering on a description of the actual working of the methods herein suggested, it will be well to mention some of the evils we are accustomed to meet with in this line of work, such as swelled teeth, scabbed teeth, and wheels which evidence carelessness on the part of either pattern maker or moulder, or both, from the fact of there being narrow and wide teeth all round the wheel. To make good sound teeth, sand must be used on which reliance can be placed—something which has stood the test. When satisfied on this point, be sure to have it thoroughly mixed with the requisite quantity of sea coal, and not over damp. Before commencing to ram a tooth, thrust a vent rod through the middle of the space down into the cinder bed below; ram a little at a time, firmly, but not too rashly, with a rammer made of wood; the bottom and all along the edge require special attention, otherwise soft places will be found. It is then that the work of destruction begins if the tools are resorted to. Better destroy the tooth and make it over again, than to waste time in finishing and have bad teeth after all. By ramming the tooth with the vent rod in place you are sure that all sides are equally benefited; the wire can be withdrawn when the top is reached, and the hole plugged. This relieves all anxiety about the iron entering the vent if there should be any fin or clearance when the cope comes on. To secure correctness in spacing, take the time necessary to do it right. If the segment should happen a little under or over, don't imagine that you can bring it all right by making a little allowance either way as you go round, only to find yourself mistaken at the last move, and, rather than destroy what is done, shave off a little, or divide the difference, as the case may be; but try it again until it is right.

Fig. 5 is an isometrical view of the mould when swept as directed. The spindle is 3 inches in diameter, turned all its length. The arm is bored to fit snugly, and planed along the top side to a right angle with the bore. It is made to run loose on the spindle, and rests on a collar held in place by a set screw. Instead of securing the segment to the arm proper, I have shown an attachment (which can be adjusted to the segment by the pattern maker), the top inner surface of which is planed, and, as is seen, rests on the trued surface of the arm. The planed surfaces allow of an easy adjustment of the segment, without fear of altering the angle to which it was originally set. This arrangement admits of a set screw being fitted on the top, by which means the segment can be lifted clear of the bed (when it is being tried around for the number of teeth) much quicker and without help.

The bracket, seen on the back of the segment, not only serves to secure it to the arm, but must be planed so that, when it is correct to the spirit level, the face of the tooth will be at the angle required. When the segment is set correctly, put a bolt through the slot shown and screw fast, then lower the whole down into place and mark opposite the lines on center of teeth all round to the starting point. Should it be found to come a little under or over the number of teeth required, increase or decrease the diameter to suit the case, but be sure you are correct before commencing to ram the teeth, and take care to be exactly opposite the mark each move. The view shows three teeth rammed and the segment lifted clear of the last tooth, but it is not intended that the collar on which the arm rests shall be disturbed, after it is once set, until all the teeth are made. When the teeth are finished take a segment or half circle which fits the spindle and extends to the diameter of the core, and bed it round the spindle to form a seating in which to rest the core. Should a washer be required on the face or bottom side, similar to the one shown on the top, it can be done the same way. If proper care has been exercised on all the details of this job it will be found, when closing the mould, that everything will find its place as surely as would have been the case if a full pattern had been used.

If a man truly desires to know how deeply he is posted on any subject, let him write an article upon it. If he goes at the matter considering the world his audience, and writes nothing but what he feels will stand against all criticisms if brought to argument, he will be a much wiser man at the close of his article than when he commenced. I can truly say my writing has done me personally more good in understanding the true principles of our trade than if I had had a hundred lives' work in the manner generally practiced. The good derived from writing is obtained simply from the fact of making one study and originate. —Thos. D. West in *Machinery Moulders' Journal*.

The Engineer (London) tells of a theater there upon the stage of which steel rails are laid and a real locomotive draws a train of cars over them. The locomotive is steamed up, the engineer is at his post, and there are all the other accessories of the real thing.

What perplexes us is to decide whether the man at the throttle is, strictly speaking, an actor or an engineer.

In a note to the Pittsburgh *Commercial Gazette*, Andrew Carnegie points out that pig iron for steel can be produced as cheaply in Chicago as in Pittsburgh.

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NEW YORK, MARCH 31, 1888.

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Nothing New.

It is an easy matter to prove that there is nothing new in the world, and it has come to be the fashion to belittle about every invention made, by showing that something in some respects like the thing invented has been known or dreamed of before. As a general thing these rusty resemblances are matters of very little consequence. They go to show that some one has tried to accomplish a certain purpose and has failed, his failure resulting in no benefit to the public.

When an inventor brings out something that accomplishes a useful purpose not before accomplished, or does this better or more economically than it has been done, it is reasonably certain he has invented something in the value of which he has an interest. And this point is the one that is overlooked by those who declaim against the rights of inventors in favor of some one who tried to do something similar twenty years before. The very fact that the party who tried first did not succeed is fairly good evidence that he did not make the invention. All recent construction of patent law is in favor of sustaining the inventor who accomplishes something, as against the man who has tried and failed, even though the means used are very similar. And this is justice and common sense. The patent laws are presumably in the interest of the public, and the public is interested in the inventor to exactly the extent that it is benefited by him.

The same spirit that leads people to detract from the credit of others by unearthing old material things that were never of any practical utility, leads them to a good deal of useless trouble in the way of digging up obsolete ideas and expressions to show that some modern writer has, after all, told nothing new, although to ordinary readers it may be of great practical value. In this case, as in the case of the machine or other patented device, the man who gives the knowledge to those who are in search of it, is the one who deserves praise. It makes but little difference whether he does this by adding something that was lacking, or by putting what is really complete in its way into such shape as will make it serviceable to others.

There are a hundred devices not patented nor patentable, used here and there for certain mechanical purposes, that a knowledge of would be of material advantage to others. But those who could make this knowledge known are very frequently hindered from doing so because there is in all probability, somewhere, a man who stands ready to affirm that he has seen and used the same device. The knowledge of many a good thing is kept from being made common because those who possess it are reasonably certain that it is not absolutely new. The man who has "seen it before" is not always a public benefactor, although he may be a very observing person.

Where is Public Sympathy?

The letter carriers of New York city have for two years been trying the power of argument and persuasion, to the end of having their hours of labor lessened. But their efforts have been in vain. In fact, with the exception of an occasional congressman, who, it is supposed, may have some influence in the matter, no one appears to pay any attention to their appeals. The public, that is always said to be right in such things, cannot be brought to move in their behalf.

It is doubtful if there is as hard-worked a class of men in this city as the letter carriers. Those who work from the main office must begin their duties—getting ready for the first delivery—at six o'clock, and continue each other day until a quarter of five—ten and three-quarter hours—and each other day till six o'clock, or twelve hours. Loaded down like pack-horses, they climb stairs, and literally *race* the streets, with never a minute to spare, and in all kinds of weather. Those carriers who work from up-town offices are still worse off as to hours, beginning at six and working till six each other day, and each other day till half-past nine.

The letter carriers of New York must be men of good intelligence, honest, good-natured and obliging, and the work they are obliged to do is, owing to its laborious character and the long hours, so arduous that they can work at it but a few years at the most, and then they are prematurely old and unfit for any kind of work. They are permitted to make $600 the first year, $800 the second year, and the third year—if they live so long—and thereafter, $1,000. Permitted to make, for it must not be supposed they get this in the way of a salary. On the contrary, if they lose so much as a trip it is deducted from their pay. But assuming the pay to be satisfactory for reasonable hours, it is disgraceful for a great government to keep men at such kind of work from 11 to 15½ hours a day. And it shows a lack of sympathy on the part of the public, who are so faithfully served by the letter carriers, that they do not aid them in securing shorter hours of service. There is a good deal of humbug about the sympathy of the public. When it would be of avail it is seldom forthcoming.

Electric Motors and the Steam Engine.

There are certain enthusiasts who do not hesitate to say that the motor of the future will be the electric motor, and that the use of motive power is to be almost indefinitely extended. But, with curious inconsistency, they assert, in the same breath, that the steam engine must go. Those who look a little deeper into cause and effect understand that if the wildest dreams of electric enthusiasts were instantly realized, so far as to use electric motors—if it were possible—wherever power is now furnished direct by steam engines, the world would be enormously short in steam engines, and steam engine building would be, for a time, by far the greatest business of the age. The power that does the work of the world by steam would be entirely inadequate if this power had to be furnished through the connecting link of electric motors, with the attendant waste of energy.

The steam engine will stand at least until the dreams of those who hope to make electricity direct from coal assume tangible form, and even then there is great probability that it will continue to be 'the great prime mover." This is not saying that electric motors will not come to be used to a considerable extent, but steam engine builders can console themselves with the fact that every one substituted for steam direct will give them more instead of less work.

Those who reason that the substitution of machinery for manual labor will have a bad effect, in that it will deprive working people of work, lose sight of the fact that the greater part of the work of the world is done *for* those who work. As men come to be able to produce more by the aid of better improved machinery, their wants are correspondingly increased, and in the end the two should balance each other. If, by the use of machinery, any considerable portion of the people are deprived of work, the end of using such machinery will be defeated, because the market for its product will be diminished. If one-half the men now employed, do, by the aid of machinery, all the work required, then the other half will have no money to buy what is produced, and the competition between the employed and unemployed will be so fierce that the wages of those who work will not permit them to buy more than the barest necessities. And this would go on until there would be nothing manufactured, because there would be no one to buy, the capitalist's capital being scarcely more potent than the poor man's poverty. This is a conclusion at once illogical and absurd, but one that must follow if machinery, no matter to what efficiency it is brought, is to work the purpose that some well-meaning people fear or believe it will. The greater part of the inhabitants of the world must have the opportunity to produce, and the ability to use the things produced, or civilization will cease.

Questions and Answers.

Under this head we propose to answer questions sent us, pertaining to our specialty, correctly, and according to common-sense methods.

Every question, to insure any attention, must invariably be accompanied by the writer's name and address. If so requested, neither name, correct initials nor location will be published.

(162) L. G., Cleveland, Ohio, asks: 1 Where, and how many horse-power, is the largest stationary engine in the world? *A.*—We do not know. 2. How much would a railroad rail expand when the thermometer ranges from 10 degrees below to 98 degrees above zero? *A.*—That depends upon the length of the rail. You can find the amount of expansion by the following formula:

$$0.0012 \frac{t_1 - t_2}{180} l.$$

In this formula t_1 and t_2 are the highest and lowest temperatures Fah., l the length of the rail in inches.

(163) Experiment, Syracuse, N. Y., writes: 1. A party has an apparatus in operation with which he wishes to use hot water at one hundred pounds' pressure to pump cold water at the same pressure. If the hot water has plenty of room through large ports to enter and leave the cylinder without loss of pressure, will there not be as much heat per pound left in the water as before it moved the piston? *A.*—No. 2. The object is to have the heat take away as much water as possible after leaving the pump; without passing through the pump, one per cent. of the water will become steam for every ten degrees fall of temperature. Will not the same results be obtained if the water first moves the piston with little friction and no loss of pressure? *A.*—You have not given sufficient data for us to answer the question.

(164) J. M., Canada, writes: I would like to ask your opinion as to the cause of circular saws breaking under the following circumstances. I might add it occurs more in shingle saws. The temper is all right. They are left as hard as they will set after being ground. They have broken in smithing and grinding. In fact, there was one broke after it was smithed when lying on the anvil. A fellow workman heard a click, and asked, "What is that?" At this juncture another was heard, and on examining we found two cracks about ¾ of an inch long. Had a saw 30 inches in diameter break in grinding half way to the center. I might say it would swage all right. *A.*—A circular saw when running at high speed will expand more at the rim than at the center, due to the heat caused by friction and cutting the material. Consequently, the saw-straightener will compensate in advance for this expansion by giving the rim a certain amount of tension. Now it will readily be seen that placing the saw on an anvil and thus exposing the saw to an even temperature—that is, to a temperature due to the anvil, and another temperature due to the surrounding atmosphere—may, in connection with the uneven tension in the saw, produce fracture. The breaking of the saw may also be due to an excessive tension, to bad material, or an incorrect temper.

(165) J. C, Pleasant, Ind., writes: 1. I have a six-horse Baxter engine; could it be arranged to burn oil for making steam? If so, what change would be necessary, and about how much do you think it will cost? *A.*—The engine can be arranged to burn oil, in a manner similar to that adopted for an experiment by the elevated railroad of New York. This arrangement you will find described in the American Machinist, p. 7, Nov. 12, 1887, and indicates the change and additions which will have to be made. As to the cost, it is impossible for us to say, since we do not know how near you are situated to machine shops, or what convenience you have for making the change yourself. 2. Would it pay to make the change? *A.*—That depends on the difference between the price of coal and oil in your neighborhood; this difference we do not know. 3. I have a Hancock inspirator; it is entirely too large for feeding the boiler. Are there any parties who make an inspirator or injector for this size engine small enough to keep it constantly supplied with water? *A.*—Write to the Hancock Inspirator Company, Boston, Mass. Or if you prefer an injector, write to the different makers of injectors. 4. How could I make some valves tight without taking them off? *A.*—You will have to take them off for examination.

(166) E. H, Indianapolis, Ind., writes: Please give me the proper size of ports and lap of valve for a 4 and 6 horse-power engine. *A.*—You can find the dimensions of steam and exhaust ports by the rules given in the American Machinist, p. 5, Sept. 5, 1885. For the amount of lap required, see American Machinist, p. 6, Nov. 21, 1885. 2. Should shaft governors be made so that when the weights are pulled out, when the engine is on the dead center, the valve will not move? *A.*—There are shaft governors made in which the weights can be

moved outwards without moving the valves when the engine is on one of its dead centers; there are other shaft governors in which this cannot be done. The former class of governors are employed when only one valve is used for controlling the admission, cut-off, and exhaust of steam. The latter class is employed when a separate valve for cutting off is used. 3. Would I obtain any advantage by using an arrangement for balancing the slide valve as shown in the sketch? *A.*—You will gain an advantage by balancing the valve, but not by the arrangement shown, which is a very poor one. As to answering questions, it makes no difference whether they are sent by subscribers, readers, or others. We answer them whenever their turn comes.

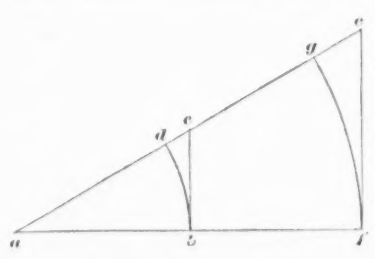
(167) J. B., Pottstown, Pa., writes: I am superintendent of a nail plate mill, and have some hard luck. My finishing (chilled) rolls shell or spaul out, and I write to ask how to prevent it, and to know the cause of it. *A.*—We believe that your trouble lies in the manner of casting the rolls and in the selection of the iron for the same. We would advise you to employ a person who has had experience in making rolls of this kind, and is thoroughly competent to do so.

(168) C. W. H, New York, sends us a sketch of an arrangement, which, evidently, is to be used for heating buildings. In the exhaust pipe of a steam engine cylinder a back pressure valve is placed close to the cylinder. Above this back pressure valve, and in the same exhaust pipe, is placed a globe valve; between the two valves is attached a pipe for heating the building. He asks: Is the back pressure valve in its proper place, or should it be where the globe valve is? *A.*—The valves are placed correctly.

(169) H. R. D, Jeansville, Pa, writes: I am building a boiler, locomotive type. The barrel is 18 inches in diameter, 28 flues, 18 inches long and 1½ inches in diameter; grate, 14 x 15 inches; distance between grate and crown sheet, 17 inches; dome over fire box, 9 x 9 inches; half inch stay bolts placed 3 inches from center to center. Do you think this boiler is large enough to run a 2½ horse-power engine? And will it be safe to run with a steam pressure 80 pounds to the square inch. Steel is used 3-16 inch thick. *A.*—The boiler is large enough, providing the engine connected to it is correctly designed and proportioned; but if economy of fuel is to be taken in account, we prefer a larger boiler. The boiler is also strong enough, providing you use the best quality of iron for the stay bolts.

(170) E. D., Ellis, Kan., writes: Would you please state the best method of keying and setting eccentrics in locomotive driving axles? *A.*—For the method of setting eccentrics, see AMERICAN MACHINIST, April 30, p. 5; May 14, p. 5, and May 28, p. 7, 1887. After the eccentrics have been set and held in position by set screws, mark off on the axle the keyway previously cut in the eccentric wheel, then move the eccentrics out of position, and cut the keyways in the axle. To do this, some mechanics use a flat nose drill for drilling a required number of recesses to make up the length of keyway; the depth of recesses are made equal to the depth of, and the diameter of recesses equal to width of keyway; the metal between the recesses is then chipped out by hand, and thus the keyway is formed.

(171) J. B. L., Charleston, S. C., writes: As you are in daily receipt of catalogues of machinery and tools, would you kindly send me one from Hill, Clarke & Co., Boston, Mass., or obtain one for me. *A.*—Write direct to Hill, Clarke & Co.; we believe they will take pleasure in sending you one of their catalogues. 2. Please give me a rule for calculating the number of degrees in different angles, when the lengths of the horizontal line, and the perpendicular line opposite the required angle are given. *A.*—Divide the length of the perpendicular line by the length of the horizontal line; the quotient will be the tangent of the angle. In a table of natural sines and tangents, look for this tangent; in the same line with it you will find the number of degrees contained in the angle. This rule is based on the following principle found in trigonometry. Let *a b* be the given horizontal line, *b c* the perpendicular line. Join the extremities *a* and *c* by a straight line, then will *a b c* be a right-angled triangle. From the vertex *a* as a center, and with a radius equal to *a b*, describe the arc *b d*. A straight line drawn so that it will touch the arc *b d* in



one point only is called a tangent. Consequently, the line *c b*, which is perpendicular to the line *a b*, and touching the extremity *b* of the arc *b d*, is a tangent. If the line *b c* is limited by the line *a c*, drawn through the vertex *a*, and the extremity *d* of the arc, then the line *b c* will represent a trigonometrical tangent. If now we consider the radius *a b* to be equal to a unit, that is, equal to 1, then the length of the line *b c* will represent the natural tangent of the angle *a*. Therefore if we know the natural tangent of any given angle or arc, we can readily find the tangent of an arc containing the same number of degrees, but drawn with a longer radius. Thus, if the radius *a b* is equal to one foot, and the angle *a* contains 30 degrees, we will find the line *b c*, that is the natural tangent, to measure .5773 of a foot. If now *a f* is 2 feet long, and the arc *g f* contains the same number of degrees, namely 30, then the length of the tangent *e f* will be equal to twice the natural tangent *c d*, that is, .5773 × 2 = 1.1546 foot; and conversely if we know the length of the lines *a f* and *e f*, we have only to divide the line *e f* by the line *a f*; the quotient will be the natural tangent, and the number of degrees in the corresponding arc is found in a table of natural tangents.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Wednesday for the ensuing week's issue.

Planed bevel gears. Grant, see page 16.

Link-Belting.

Send for catalogue of Link-Belting.

Over 50,000,000 feet of Link-Belt in use.

Link-Belt Machinery Co., Chicago and N. Y.

Before you buy a lathe write Lodge, Davis & Co

Before you buy a shaper write Lodge, Davis & Co.

Before you buy a drill press write Lodge, Davis & Co.

Before you buy a brass lathe write Lodge, Davis & Co.

Before you buy any machine tools write Lodge, Davis & Co.

Special drives in 2d-hand tools Lodge, Davis & Co.

See special ads. pages 15 and 16, Lodge, Davis & Co.

Shafting Straighteners. J. H. Wells, Tampa. Fla.

Steel Name Stamps, etc. J. B. Roney, Lynn, Mass.

Lamb Knitting Machine Co., Chicopee Falls. Mass.

Machine work and pattern making. Anderson Machine Works, Peekskill, N. Y.

Light articles built to order by the American Sewing Machine Co., Philadelphia, Pa.

The Best Upright Hammers run by belt are made by W. P. Duncan & Co., Bellefonte, Pa.

Pattern and Brand Letters. Vanderburgh, Wells & Co., 56 Beekman street, New York.

Mechanical drawing, calculations, etc., taught by mail. I. D. Boyer, 324 E. 3d st., Dayton, O.

Castings for small and medium sized vertical engines. Humphrey's Foundry, Bellefontaine, O.

Solid Nickel-Seated "Pop" Safety Valves. Consolidated Safety Valve Co., 111 Liberty st., N. Y.

R. Dudgeon, 24 Columbia st., New York. Improved Hydraulic Jacks and Roller Tube Expanders.

Light and fine machinery to order; foot lathe. Catalogue for stamp. E. O. Chase, Newark, N. J.

Davis Key-Seating Machines, kept in stock, by Manning, Maxwell & Moore, 111 Liberty st., N. Y.

For first-class automatic engines write to Williams Engine Co., 447 North street, Baltimore, Md.

"Bradley's Power Hammers, the best in the world." 20 sizes. Bradley & Co., Syracuse, N. Y.

"How to Keep Boilers Clean." A book mailed free, by James E. Hotchkiss, 120 Liberty st., N. Y.

Ice and Refrigerating Machines, 124 built, and all successful. David Boyle, 521 Monroe st., Chicago, Ill.

Selden Packing, for stuffing-box, with or without rubber core. Randolph Brandt, 38 Cortlandt st., N.Y.

Burnham's turbine wheel is sold at net price to mill owners. Catalogue free. Address York, Pa.

The Improved Tabor Steam Engine Indicator, made and sold by The Ashcroft Mfg. Co., 111 Liberty st., N. Y.

For the latest improved Diamond Prospecting Drill, address the M. C. Bullock Mfg. Co., 138 Jackson st., Chicago, Ill.

Engine lathes, hand lathes, fine tools, files and supplies for machinists and other metal workers. Frasse & Co., 92 Park Row, N. Y.

Nicholson & Waterman, Providence, R. I., two 48 in. horizontal boring mills; 5 in. cutting-off machines; 14, 16, and 30 in. engine lathes.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker st., Philadelphia, Pa

Robertson's damper regulator; no diaphragms, springs or packing; the cheapest good regulator in market. Hine & Robertson, 45 Cortlandt st., N. Y.

Iron, brass and copper spooled wire is a necessity to the consumer and a great convenience to the trade. S. A. Smith, agent, 23 Canal st., Chicago, Ill.

Curtis Pressure Regulators, Curtis Return Trap, Curtis Damper Regulator. See March 10, p 10. Send for circular No. 17. Curtis Reg. Co., Boston, Mass.

Machinists' supplies, brass goods, m'f'rs' supplies, polishing materials, all kinds wire, metals, etc., in any quantity. Jordan & Gottfried, 208 Canal st., N.Y.

For Best Return Steam Traps, Pressure Regulators, Positive-Acting Pump Govs., Back-Pressure Valves. T. Kieley, 11 W. 13th st., N.Y. Send for des'n.

The Holly Manufacturing Company, of Lockport, N. Y., will send, on application, their pamphlet, illustrating pumping machinery and reports of duty trials.

New book on gears; ask dealers in books and machinists' fine tools to send for one, or send for one yourself by P. O. note. Price, 50 cents. Address Chas. B. Long, M. E., Worcester, Mass.

Randall's copper-tipped hammers are something that every machinist should have; ask your dealer to show you one, and if he does not keep them, write to Montgomery & Co., 165 Fulton st., N. Y.

W. H. Hoffman, consulting engineer, 94 Liberty st., N. Y. Mechanical engineering in all its branches; working drawings for the transmission of power by steam, water, air and electricity.

Special facilities for manufacturing of all kinds of light hardware and novelties by contract or otherwise; presswork and stamping done on short notice. Acme B. H. Att Co., Limited, 74 5th ave., N. Y.

Parties requiring milling machine or screw machine work furnished, in large or small quantities, will please write to the manufacturers, E. E. Garvin & Co., 139, 141, 143 Centre st., New York City.

Hot Water Supply. A practical treatise on the fitting of hot-water apparatus for domestic and general purposes. By F. Dye. 82 pages, with 25 illustrations. 12mo., cloth, $1. Send for catalogue. E. & F. N. Spon, 35 Murray st., N. Y

Wanted—Numbers 1, 2 and 4 of volume IV., 1881; must be in excellent condition for binding; if soiled we cannot use them; for copies described as above we will pay 25c. each, and prefer to have the whole three if possible. Parties favoring us will kindly write name and address on wrapper. AM. MACHINIST Publishing Co., 96 Fulton street, N. Y.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator, and making all required calculations from the diagram; also the principles of economy in operating steam engines, and current practice in testing engines and boilers. Price, $2, postpaid. Published by John Wiley & Sons, 15 Astor Place, New York

"Binders" for the AMERICAN MACHINIST. Two styles—the "Common Sense," as heretofore sold by us, and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers, the full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUB'G CO., 96 Fulton st., New York.

The series of articles by J. G. A. Meyer, on "Practical Drawing," now running in the AMERICAN MACHINIST, should be closely followed by every student. They commenced with October, 23, 1886 issue, and up to and including January 14, 1888 issue, 41 articles have been so far published. Copies containing these articles, sent by mail to any part of this country or Canada, at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton street, New York.

"Modern Locomotive Construction," by J. G. A. Meyer. The above series of articles, now running in the AMERICAN MACHINIST, are attracting the attention of railway mechanics all over the world. Commencing with the June 27, 1885 issue, 56 articles have thus far appeared up to and including the January 21, 1888 issue. Copies containing these articles sent by mail to any part of the U. S. or Canada at 5 cents each. AMERICAN MACHINIST PUBLISHING CO., 96 Fulton street, New York.

MANUFACTURES

The Lockwood cotton mill at Waterville, Me., is being enlarged.

The Bellevue, Pa., Electric Railway will be changed to a cable road.

Erie, Col., offers to donate a site and furnish fuel free to any one who will establish a canning factory.

The Chemical Engine Company, of Kingman, Kan., propose to move to Denver, Col., if the citizens will subscribe $50,000 to the stock.

The Grant Locomotive Works, Paterson, N. J., contemplate extensive enlargement of their entire works—machine shops, foundry, boiler, and blacksmith shops.

John Wiley & Sons, 15 Astor place, New York, have issued a catalogue, free, of text-books and industrial works which will be an advantage to mechanics and engineers desirous of making selections.

The Edwards Manufacturing Company, Augusta, Maine, will soon put in nine of the new Holmes water-wheels at their electric light and power station on the east side. These wheels represent 1,700 horse-power.

The Kokomo, Ind. *Gazette-Tribune* says: Manufacturers that want the earth, and a part of New Jersey, are not the ones Kokomo is looking for. There are plenty of that kind looking for Kokomo, but Kokomo is not looking for them at all.

The Kenyon iron foundry at Steubenville, Ohio, which has not been operated since the flood of 1884, is to be opened by Geo. L. Coon & Son. The foundry will be opened on general work, but will eventually go into the manufacture of stoves.

R. Hoe & Co., New York, send us a finely illustrated circular of the fast presses for newspaper, pamphlet and book work made by them. The circular is printed on a very fine quality of paper, and as might be expected, is typographically perfect.

The citizens of Pontiac, Mich., have voted to bond the city for $35,000 to secure the removal of the Gale Plow Works there. Water-works and electric lights will be put in this spring; $7,000 has been raised to erect buildings for Taylor's Wagon works.

A New Orleans dispatch says: A successful exhibition has been given of a new machine for cleaning cotton seed. Experts are of the opinion it will revolutionize the present system and largely increase the quantity of lint cotton. The machine is the invention of J. Howard McCormick, a young man of this city, and its chief feature is it cleans the seed perfectly by steel brushes, leaving the lint as clean as from the gin.

J. P. Richards, Providence, R. I., has issued a small catalogue, very finely illustrated, of standard punches and dies for punching all kinds of sheet metal, boiler plates, bridge iron, ship iron, etc. Mr. Richards was, as far as we know, the first manufacturer to make a business of such punches, and we are glad to know is meeting with good success. He has made a study of the business, and guarantees his standard work to give satisfaction.

The Lidback Manufacturing Company has been organized at Portland, Maine, with a capital stock of $100,000, to manufacture the engine invented by J. A. Lidback, of that city The officers of the company are as follows: President, Charles B. Strout; treasurer, Horatio Hight: directors, C. B. Strout, H. Hight, J A. Lidback, M. C. Foss and H. S. Osgood; mechanical engineer, J. A. Lidback. The company will develop the business of the present Lidback Machine Works, and will proceed to increase the working force in the shops at once.

The Fall River *News* says: "Several gentlemen, who have been talking of erecting a large shoe factory in this city, have decided to locate at Haverhill, Mass., not being able to secure the site they had selected here. The company represented a capital of between $80,000 and $90,000, and was composed of outside capital. The location desired was just outh of the south park, and though there are fine locations farther south and in other sections, which could probably have been obtained on satisfactory terms, the shoemen would only be satisfied by a *sole* location, which they could not get."

Hill, Clarke & Co., Boston, Mass., have put upon the market a mandrel forcing machine that it appears will be appreciated. It is designed to supersede the barbarous use of the sledge for forcing the mandrel into work to be machined. A ram of short stroke, driven by a belt, delivers the blows, the ram making from 175 to 200 strokes per minute. By means of a hand wheel and screw the operator follows up the blows of the ram as delivered. The distance between the uprights of the machine is 36 inches greatest distance from the base to the end of the ram is 33 inches, and the screw in the ram has a travel of 18 inches. Several stands of different heights are provided for holding the work. The machine will receive mandrels up to 5¼ inches in diameter. It is a very solid and substantially built machine, and we should think a very useful one.

Coraopolis [Pa.], a station on the P. & L. E. Railroad, within a short ride of the city, is soon to be classed among the manufacturing towns of this region. The Pittsburgh Specialty Manufacturing Company, located in rather close quarters on Twentieth street, South Side, for the past two years, has completed the foundation for a large establishment at Coraopolis. Sufficient ground has been donated by the citizens, and a substantial brick building, 50 x 120 feet, will soon be commenced. Natural gas will be used in the establishment. It is the intention of the Pittsburgh Specialty Manufacturing Company to put up a Bessemer steel plant within a year, and extend operations generally. At the start, about 150 men will be employed. The work done by this company, which is the manufacture of steel specialties for agricultural machinery, illustrates the fact that the Pittsburgh district is making great progress in a line of which little has been published. The great agricultural machinery manufacturing establishments of the West, in reality manufacture very little. The various parts of their machines are made elsewhere, and shipped to the western headquarters ready for putting together. The work done in the finish is nothing more than drilling a few holes and setting up the machines. The substitution of steel for the heavy woodwork formerly used in building agricultural machinery has done much to bring this class of work to Pittsburgh.—*American Manufacture.*

Mr. H. Haberlin, who has been with the Webster, Camp & Lane Mfg. Co., Akron, O., for the past five years, has severed his connection with their department of design and associated himself with Mr. C. L. Redfield, of Minneapolis, Minn., under the firm name of Redfield & Haberlin, who will carry on a professional business as mechanical engineers. Among the new machine designs lately turned out by Mr. Redfield may be mentioned an adjustable wood shaper for J. H. Kerrick, a wood embossing machine for Daniel Burdette, a high speed automatic engine for W. H. Getchell & Co., a high speed stone sawing machine for Frederick Jenkinson, a sewer machine for N. E. Green, a printing press attachment for A. A. McCann, and a new electrical matrix making machine for making matrices direct from dies without the use of type, for the Minneapolis Electro Matrix Making Company. Among the designs now on hand are a steam sheathing driver for sewer work, a rapid automatic straw baling machine for baling straw to be used in straw burning stoves and furnaces, and a light and compact indicator rig to go into the box with the indicator. The business of Messrs. Redfield & Haberlin is a purely professional one. They do not manufacture or sell any machinery, though they often purchase it for parties for whom they are erecting, planning, or remodeling manufacturing plants.

The Hussey Re-Heater and Steam Plant Improvement Company, 15 Cortlandt street, New York, report business as very good. They do a general engineering and steam-fitting business. Their system of re-heating exhaust steam without cost in fuel seems to be giving excellent satisfaction. The buildings of the American Starch Company, Columbus, Ind., Dutchess Hat Factory, Fishkill Landing, N. Y., the Nonotuck Paper Company, Holyoke, Mass., the Fulton Sugar Refinery, Brooklyn, and Thom's Hat Factory, Haverhill, Mass., were piped according to the plans of this company. The Hussey re-heater system, according to the statements of the company, effects a saving of 25 per cent. average, wherever applied, in some cases the saving being as high as 50 per cent. Their system can be seen in operation at the Welles Building, 18 Broadway, N.Y., and the Eagle Fire Insurance Company's building, 71 Wall street, and the Central Trust Company's building, 54 Wall street, New York. During this month the following orders have been filled: Watson's Paper Factory, Erie, Pa.; Central Trust Company, 54 Wall street, New York; Bank of New York, Wall street, and a contract has just been signed by the company to place the entire steam plant in the large apartment house at the corner of 103d street and 10th ave., New York. Levi Hussey, a name well known, especially in connection with Benj. Isherwood's experiments in superheating steam at the flour mills of the late Geo. V. Hecker, some years ago, is the chief engineer of the company. Mr Hussey is an expert in erecting and remodeling steam plants, of which this company makes a specialty in connection with its system of re-heating exhaust and super-heating live steam. This company submit plans, specifications and estimates for supplying and improving steam plants, and for appliances of all kinds in connection with the use of steam for power or heat in manufactories, stores, office buildings, hotels and apartment houses.

Machinists' Supplies and Iron.

New York, March 15, 1888.

Iron—American Pig—No important changes have occurred since our last report. We quote Standard Lehigh brands $21 to $21 50 for No. 1 X Foundry, with outside brands obtainable at $20 to $20 50. No. 2 Foundry $19 to $19.50 for Standard Lehigh brands.

✲WANTED✲

"Situation and Help" Advertisements only inserted under this head. Rate, 30 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Wednesday morning for the ensuing week's issue.

Wanted—Men to sell planes, see page 1.

Wanted—Position as machine shop foreman; engine or machinery. Practical. Am. Machinist.

Situation wanted by draftsman; college graduate and 2 years practical exp. A. O. W., Am. Machinist.

Pattern maker of experience wants situation; accustomed to general machine work. S.R., Am. Mach.

Wanted—Situation as foreman by a first-class machinist of 10 years' experience; used to handling men. F. S., Am. Machinist.

Practical boiler maker wants position as foreman, or take charge of boiler work in roundhouse, or large steam plant. Address Os, 222 S. 17th street, Harrisburg, Pa.

Wanted—Salesmen calling on the machinery and engine building trade, to sell on commission goods they all use. Record of years in leading firms. Address Box 2921, N. Y. City.

Wanted—Position as foreman boiler maker; first-class recommendations; 35 years' experience; can lay out any kind of work or take charge of any number of men. J. W., Am. Machinist.

Wanted—A foreman for machine shop; one who has had experience in building portable and stationary engines and general repair work; and who can handle men to best advantage. Address, stating expectations as regards to salary, P. O. Box C, Schenectady, N. Y.

Wanted—At the Can. Loco. Eng. Co., Ld., Kingston, Ontario, foreman pattern maker to take charge of their pattern, joiners and tender erecting shop; must be an experienced pattern maker, accustomed to locomotive work. Address, stating age, exper'nce, reference, and salary required.

Wanted—A position as superintendent or foreman by a young man who is a first-class machinist and tool maker, also a good draftsman, and has had large experience in general machine shop practice; a systematic and economical manager of men; best of reference. S., Am. Machinist.

✢ MISCELLANEOUS WANTS. ✢

Advertisements will be inserted under this head a 35 cents per line, each insertion.

Crescent steel tube scrapers are unquestionably the best. Crescent Mfg. Co., Cleveland, Ohio.

Crescent boiler tube cutter, for setting new and removing old tubes. Crescent Mfg. Co., Cleveland, O.

Wanted—Parties having machinery specialties to build, to correspond with. Box 75, Am. Machinist.

Hard rubber blowing and pressing dies and machinery a specialty. E. O. Chase, Newark, N. J.

Adamantine adhesive for making steam joints; stops leaks in boilers, stops pitting. Chas. Barnes & Co., Cincinnati, Ohio.

Wanted—Shafting lathe 24" to 30" swing, to turn 16' to 20'. Send full particulars and lowest price to Box 241, West Newton, Mass.

30 cents buys a practical pipe wrench for any purpose; Ambler's pipe attachment for monkey wrenches sent by mail upon receipt of price. Agents wanted. A. A. Ambler, Springfield, O.

A. C. Christensen, 26 Church st., N. Y., mech. and hydraulic engineer. Prepares designs of water-works pumping stations, drawings of steam pumps, pumping engines, gen. mach'ry and pat. drawings.

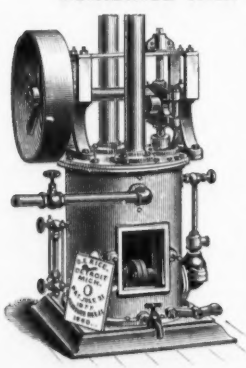
Wanted—Cheap testing machines for cast-iron to give contraction, deflection, and strength; also any other useful foundry tools. Jas. Evans & Co., Gaythorn, Manchester, England.

For Sale—In Birmingham, Ala., a machine shop, equipped with best make of new machinery; a bargain for most any manufacturer with moderate capital. Address Opportunity, Am. Machinist.

RICE'S PATENT

Feed-Water Heater and Purifier,

Combined with **PUMP,**



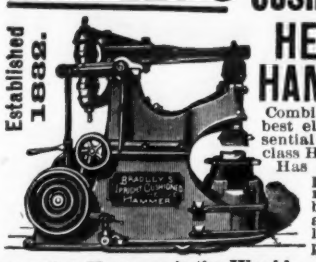
After 10 years' existence is still unequalled for durability, efficiency and economy. Manufacturers should carefully inquire whether their motive power is generated with all possible economy. Investigation costs but little time and will be very remunerative.

SEND FOR DESCRIPTIVE PAMPHLET.

Frank M. Clarkson, Detroit, Mich.

BRADLEY'S UPRIGHT CUSHIONED HELVE HAMMER

Established 1882.



Combines all the best elements essential in a first-class Hammer. Has more good points, does more and better work and costs less for repairs than any other Hammer in the World.

Bradley's HEATING FORGES

Established 1832

With a manufacturing experience of over half a century, we recommend these machines to be the best, simplest, most durable and combining all the essential elements.

Pat. Aug. 30, 1887

For hard coal or coke. Indispensable in all shops to keep Bradley's Cushioned Hammers and men fully employed and reduces cost of production.

BRADLEY & CO., Syracuse, N. Y.

STEPHENS VISES.

PATENT

ONE HALF TIME and LABOR saved by using this solid, strong, durable, firm-hold, quick-working Lever (Not Screw) Vise. Has improved Taper Pipe and other attachments. Sold by the trade. Send for circular.

TOWER & LYON,
95 Chambers Street, New York.
Successors to Melvin Stephens.

TANITE EMERY WHEELS and GRINDING MACHINES

FOR SAW MILLS, FOUNDRIES AND MACHINE SHOPS.

For Circulars address

THE TANITE COMPANY, STROUDSBURG, MONROE CO., PA.

Or H. A. ROGERS, 19 John St., N. Y.

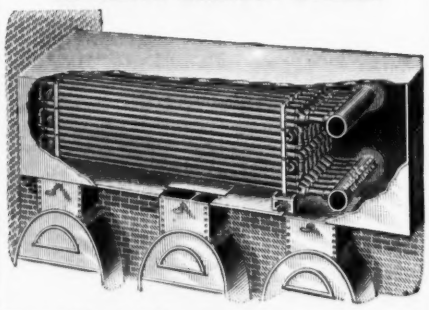
FOR SALE. Victor Colliau No. 8 Improved Cupola. Having been delivered too late to set up for a special contract, we offer the above very cheap F. O. B. our works.

Dimensions as follows: Height over all, 32 feet. Drum, 84"x8'. Stock, 60"x19', 8". Tap spout, 5' from ground line, bottom of charging door to top of drum, 6', 5"; lines up 46" inside, to run 8 tons per hour.

Todd Pulley & Shafting Works,
East St. Louis, Ill.

THE HUSSEY RE-HEATER

RE-HEATS EXHAUST STEAM.



Super-Heats Live Steam,
Heats Air or Water
WITHOUT COST.

The Hussey Re-Heater and Steam Plant,

IMPROVEMENT CO.

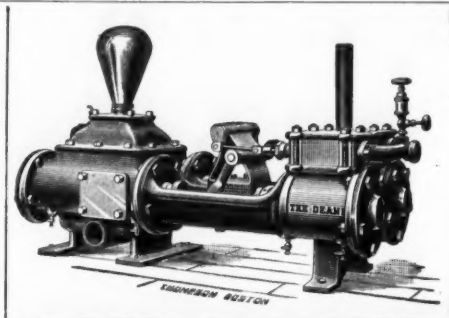
A. S. Hatch, President.
S. D. Brewer, Gen'l Manager.
15 Cortlandt St., N. Y.

"Star" Foot Lathe Swings 9x25 in. | LATHE | Screw Cutting Automatic Cross Feed, etc.

Scroll Saws, Circular Saws, Lathes Mortisers. | LATHE | Catalogue Free of all our Machinery

Seneca Falls Mfg. Co. Water St., Seneca Falls, N.Y.

IMPROVED PUMPING MACHINERY | For Every Class of Work | SEND FOR NEW ILLUSTRATED CATALOGUE.



THE DEANE STEAM PUMP CO.,

HOLYOKE, MASS.,

New York, Boston, Chicago, Philadelphia, St. Louis,

Manufacturers of

STEAM and POWER

PUMPS

FOR ALL PURPOSES.

SEND FOR CATALOGUE.

MACHINE TOOLS ON HAND FOR IMMEDIATE DELIVERY.

15in., 24in. and 25in. Pillar Shapers. 15in. and 20in. Traverse Shapers. 10in., 16in. and 22in. Planers. 18in. x 6, 8, 10 or 12ft. Engine Lathes, (New Pattern.) 10, 12 and 15in. Speed Lathes. Larger size Planers at short notice. Also our Forming Lathe for special brass work. A few 2d hand tools also on hand.

THE HENDEY MACHINE CO.,

TORRINGTON, CONN.

DRILL RODS,

The finest stock known for small taps, reamers, punches, jewelers' tools, watch and clock parts, &c. These rods work freely, harden without cracking at low heat, and are exact in size to micrometric measurement.

All regular sizes from .013" to 1⅛" diameter in 12" and 36" lengths. Other sizes to order.

MILLER, METCALF & PARKIN, CRESCENT STEEL WORKS,

CHICAGO, ILL. PITTSBURGH, PA. NEW YORK, N. Y.

Sebastian, May & Co.'s Improved Screw Cutting

FOOT AND **LATHES** POWER

Drill Presses, Shapers, Band, Circular and Scroll Saws. Machinists' Tools and Supplies. Lathes on trial. Catalogue mailed on application.

167 West Second Street, CINCINNATI, O.

OUR NEW 18 in. POWER ENGINE LATHE IS NOW READY

BUSINESS OPPORTUNITY.

Having invented a system of electric lighting and the transmission of power by electricity that embraces many new features, I now wish to associate myself with some enterprising party with facilities to put the system on the market. The apparatus has been thoroughly tested and gives an efficiency of 92 per cent. I have 800 lights in operation working by this system which gives perfect satisfaction. Send for particulars. Address W. K. F., care American Machinist, New York.

Iron Castings for Dies,

From Manufacturers' own patterns

A specialty, at Iron Foundry of

T. SHRIVER & CO.,

333 EAST 56th ST., N. Y. CITY.

Castings with nice surface and fine detail, for manufacturers of Silver Ware, Cane and Umbrella Handles, &c., &c. For information address as above.

THE Association of Engineers OF WAYS AND COMMUNICATION, OF ST. PETERSBURG, RUSSIA.

Having special Government charter favoring negotiations on a large scale and doing already a heavy business in Europe, invites American Manufacturers, Inventors and Engineers of all branches to participate in the permanent exhibition at St. Petersburg with first class prospects of doing a profitable business.

GENERAL AGENT FOR AMERICA,
A. WARSCHAWSKY,
P. O. Box 3,343. 14 Dey St., N. Y.

COPELAND OIL-BURNING STEAM ENGINE

Water, Steam, Fire. Entirely and reliably AUTOMATIC. No engineer required. Consumes about one-third as much oil as other oil-burning engines. Weight of 2 H. P. engine, 100 pounds.

Northrop M'f'g Co.,

117-121 N. Front Street,

CAMDEN, N. J.

General Agents:

Penna.: Kirk Brown, 18 S. Broad St., Phila.

Chicago: Copeland S. E. Co., 199 S. Clark St.

St. Louis: M. M. Buck & Co.

SHEPARD'S NEW $60 SCREW-CUTTING FOOT LATHE.

Foot and Power Lathes, Drill Presses, Scroll-saw Attachments, Chucks, Mandrels, Twist Drills, Dogs, Calipers, etc.

Lathes on trial. Lathes on payment.

Send for catalogue of Outfits for Amateurs or Artisans.

Address, H. L. SHEPARD, Agent, 134 E. Second St., Cincinnati, O.

Receiver's Sale.

ATLANTA MACHINE WORKS AND FOUNDRY.

UNLESS SOONER DISPOSED OF, THE ABOVE works will, under the order of the Superior Court of Fulton county, and subject to confirmation by the same, be sold to the highest bidder on WEDNESDAY, the 28th DAY of MARCH, 1888, at 12 o'clock noon upon the premises.

Lot of land, nearly two acres, only 800 yards from center of Atlanta, fronting on Hunter and King streets and the Georgia railroad, with spur tracks directly into the grounds. Largest works in Atlanta, commanding the trade of the entire South! The most complete plant in the South for manufacturing every variety of machinery, including engines, boilers, marble-cutting and gold-mining machinery, with other specialties, the demand for which is daily increasing. Substantial brick buildings with metal roofs. Apply soon for a bargain and easy payments. For full particulars address,

W. H. SMYTH, Receiver.

COOKE & CO., Dealers in

MACHINERY AND SUPPLIES,

22 CORTLANDT ST., NEW YORK,

AGENTS FOR

The Waters Perfect Governor.

Having Adjustable Speed, Automatic Safety Stop, Sawyer's Lever, and Solid Composition Valves and Seats. Also,

SUPPLIES

For Machinists, Railways, Mills, Mines, Etc.

Please send for circular and state that you saw the advertisement in this paper.

IMPROVED UPRIGHT DRILL.

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BUILDERS OF

Metal - Working Machine Tools.

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FILE CARD.

Files and Rasps

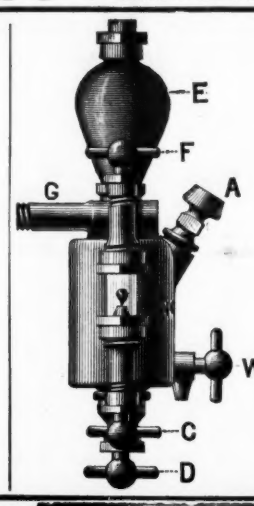
FILE BRUSH.

Having the Increment Cut.

The illustrations herewith presented exhibit more convenient and durable forms of **File Cleaners** than are usually found, the majority of those in use being rudely devised and troublesome, and we believe, for this reason, those of our manufacture will find a ready sale. Machinists and others who have not already given them a trial, will find it to their advantage to order the **File Card** and **File Brush** at once.

Manufactory and Office,

PROVIDENCE, R. I., U. S. A.



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UP-DROP, SIGHT FEED, LUBRICATOR,

(GATES PATENT.)

For Stationary Engines and Pumps of all kinds. Lubricators for Single or Double Connection.

PRICE LIST.

Nos.	1	2	3
Price	$10.00	$12.00	$15.00
Capacity	⅓ pt.	½ pt.	¾ pt.

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92 & 94 LIBERTY STREET, NEW YORK,

Send for Catalogue. **SOLE MANUFACTURERS.**

Established in 1874.

CLEVELAND TWIST DRILL CO.

24 and 26 West Street, Cleveland, O.
101 Chambers Street, New York.
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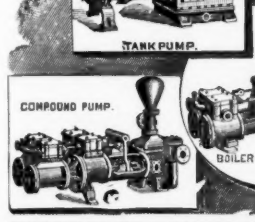
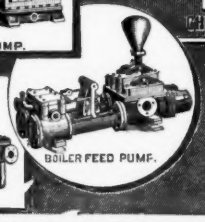

COMPOUND PUMP.


BOILER FEED PUMP.

THE VOLKER & FELTHOUSEN MFG. CO.
MANUFACTURERS OF
BUFFALO DUPLEX STEAM PUMPS.
CHURCH, BIRD'S ALLEY & MECHANIC ST. BUFFALO, N.Y.

For Sale at Factory Prices by

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For Pressure and Vacuum Gauges of every description, Exhaust Steam, and other injectors, Address,

SCHAFFER & BUDENBERG,

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WHY THIS IS PUT HERE!

For the reason that if you are interested in raising water or other liquids by steam power, we wish to call your attention to the

NEW PULSOMETER,

THE CHEAPEST AND BEST STEAM PUMP IN THE MARKET. PRICES LOWER THAN ANY OTHER.

More Efficient, Simple, Durable, and more Economical, both as to running expenses and repairs, than any other Steam Pump.

Call or write for our new 96 page Illustrated Descriptive Book containing Full Particulars, Reduced Net Prices, and hundreds of A-1 Testimonials. Mailed Free.

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ROOTS'

Force Blast Rotary Blower

FOR

FOUNDRIES, SMITH SHOPS, PNEUMATIC TUBES, VENTILATION, ETC.

SLOW SPEED.
POSITIVE BLAST.
PERFECTLY BALANCED.

Best Mechanical Construction.

P. H. & F. M. ROOTS, Manufacturers,
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COOKE & CO., Selling Agts. } NEW YORK.

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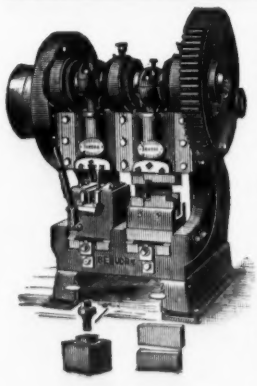

BEAUDRY'S DUPLEX Power Press

COMBINING PRESS, SHEARS AND PUNCH.

BEAUDRY & CO.

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Sole Manufacturers.

Also manufacturers of HARD COAL HEATING FORGES.

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ECONOMICAL STEAM BOILERS

A SPECIALTY.

SEND FOR PRICES. **Pond Engineering Co.** ST. LOUIS, MO.

STEEL BALLS

FOR ANTI-FRICTION BEARINGS, OF BEST CAST STEEL.

HARDENED GROUND & BURNISHED.

3-16" to 3" Diameter.

Samples and prices on application.

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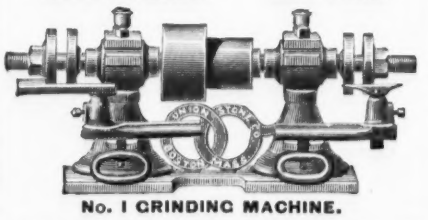
38 & 40 HAWLEY ST., BOSTON, MASS. 36 JOHN ST., NEW YORK.



No. 1 GRINDING MACHINE.

Has 1 in. Arbor. Takes Emery or Corundum Wheels to 14" diameter. Is specially adapted to grinding tools and light work of similar character.

We Manufacture Grinding Machinery and Emery or Corundum Wheels for all classes of Work.

DIAMOND TOOLS AND EMERY OR CORUNDUM WHEEL DRESSERS FOR REMOVING GLAZE, AND SHAPING THE FACE OF WHEELS, AS REQUIRED.

CATALOGUE ON APPLICATION.

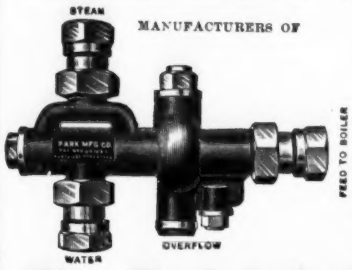
REDUCED PRICES OF LECOUNT'S STRAIGHT TAIL DOG.

To be driven from a Stud in the Face Plate.

No.	INCH.	PRICE.	No.	INCH.	PRICE
1	¾	$0.60	10	2¼	$1.35
2	⅞	.70	11	2⅜	1.45
3	1	.70	12	3	1.60
4	1⅛	.80	13	3⅛	1.80
5	1¼	.80	14	4	2.10
6	1⅜	.95	15	4¼	2.75
7	1½	.95	16	5	3.25
8	1¾	1.10	17	5½	4.00
9	2	1.20	18	6	5.00
1 Set to 2 in.		7.80	Full Set		31.10

C. W. LeCOUNT, South Norwalk, Conn.

PARK MFG. CO.



MANUFACTURERS OF

34 Beach Street, Boston, Mass.

The Park Injector,

EJECTORS AND JET APPARATUS.

MACHINE TOOLS

Special or General, any size, for the manufacture of Ordnance, Locomotive, Marine and Stationary Engines, Ships' Boilers, &c., supplied to many leading Firms in the United States of America.

Asquith's Patent Radial Drills

Unequaled by any in the World. Send specification of requirements. Large Stock of Tools ready for delivery.

W. ASQUITH, HALIFAX, England.

MONTGOMERY & CO.,

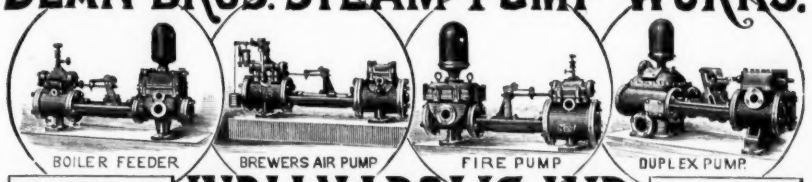
105 FULTON ST., NEW YORK,

TOOLS, SUPPLIES AND MACHINERY

FOR ALL BRANCHES OF THE MECHANICAL TRADES.

Illustrated Catalogue (300 pages) mailed on receipt of Fourteen Cents.

DEAN BROS.' STEAM PUMP WORKS.



PUMPING MACHINERY FOR ALL PURPOSES. **INDIANAPOLIS, IND.** SEND FOR CATALOGUE AND PRICES.

FOR IMMEDIATE DELIVERY.

No. 3 BRAINARD MILLING MACHINE, Complete.
No. 3 DALLETT PORTABLE DRILL.
One 24"x24"x6' WHITCOMB PLANER.

TALLMAN & McFADDEN,
1025 Market Street, Philadelphia, Pa.

Hall STEAM PUMP CO., Steam Duplex Pump.

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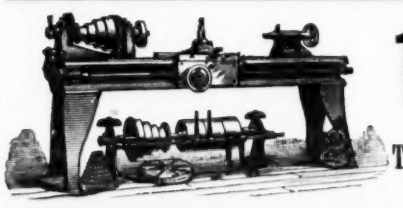

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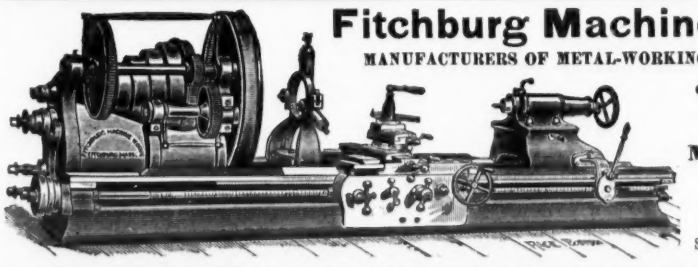

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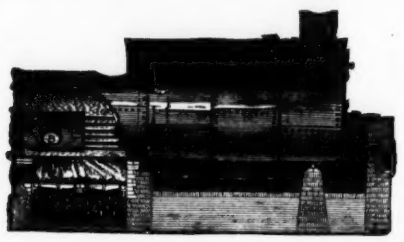

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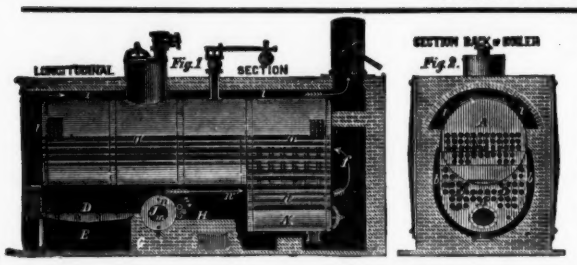

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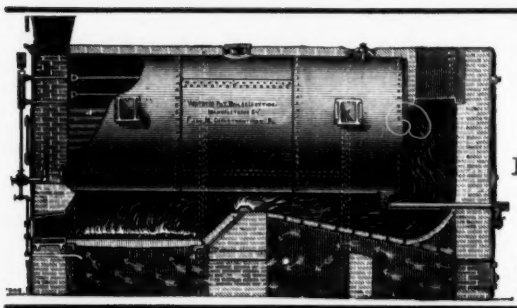

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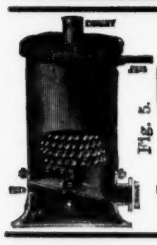

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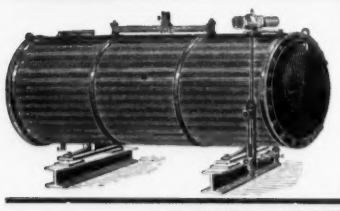

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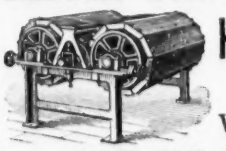

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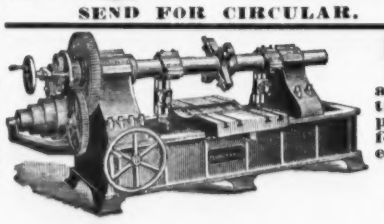

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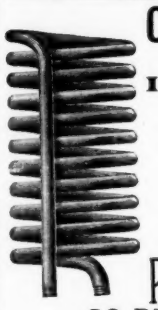

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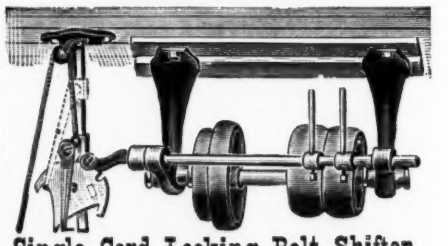

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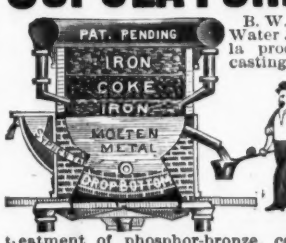

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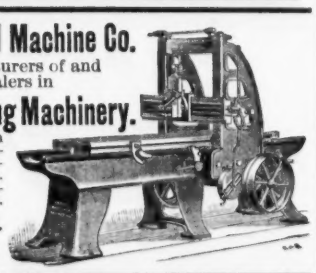

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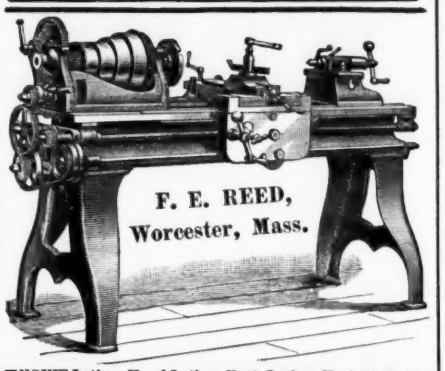

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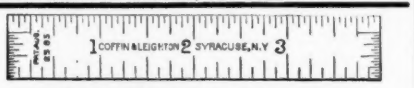

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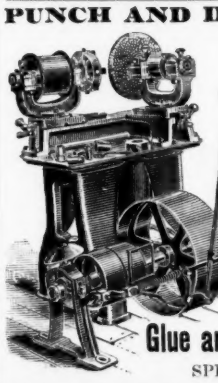

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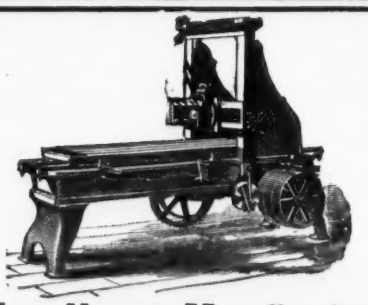

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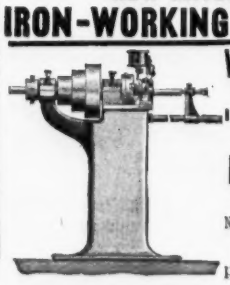

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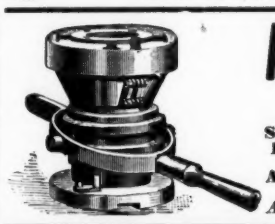

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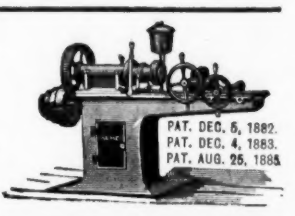

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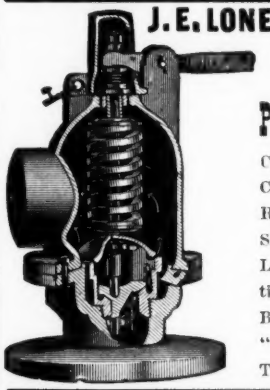

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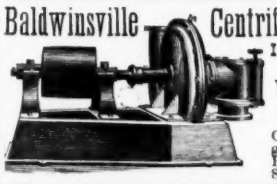

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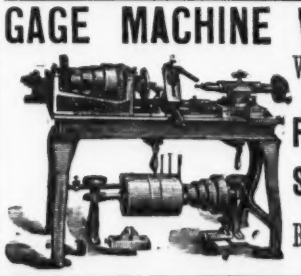

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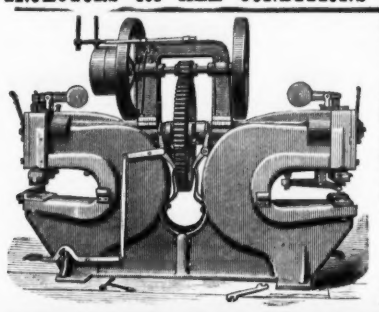

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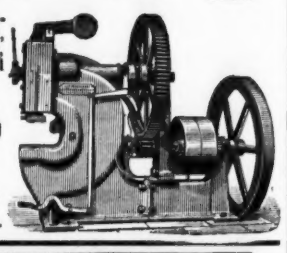

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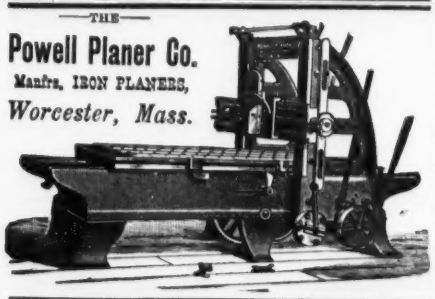

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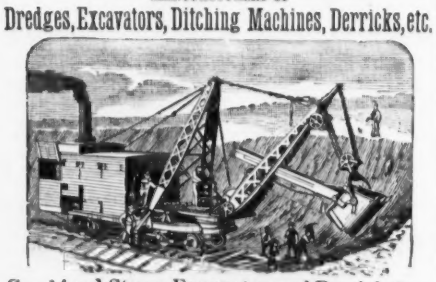

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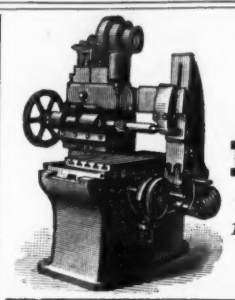

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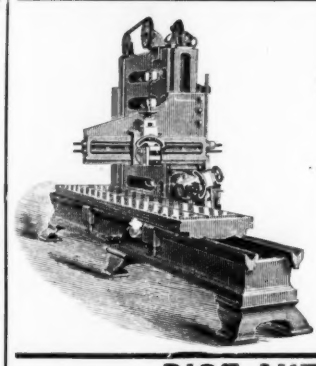

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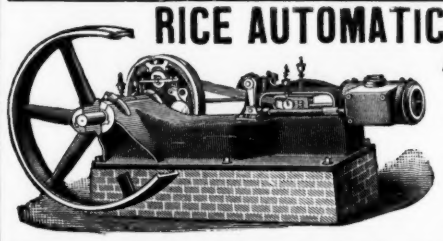

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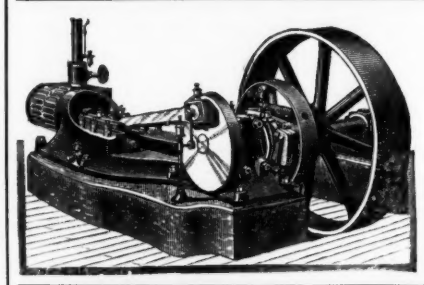

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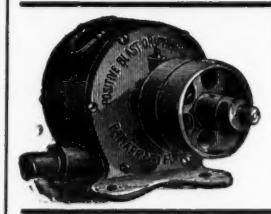

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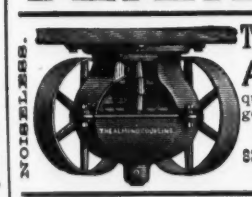

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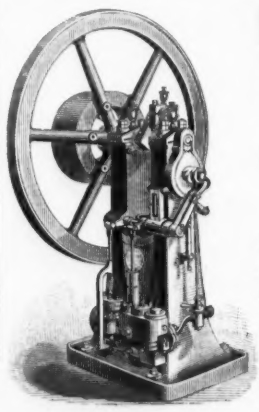

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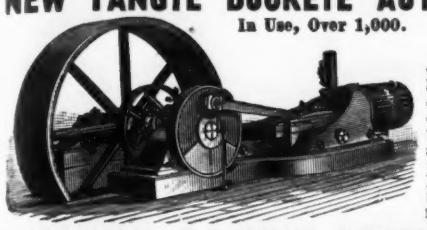

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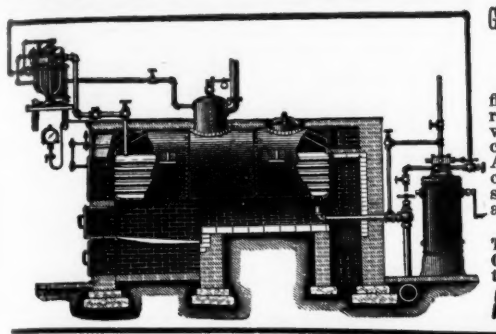

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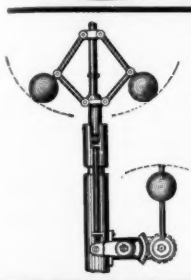

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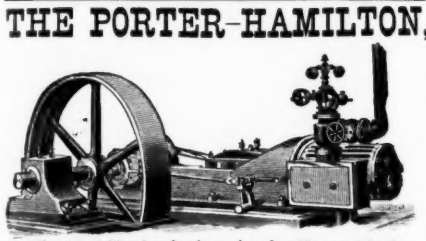

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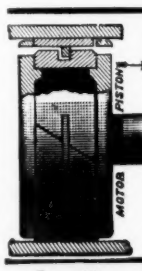

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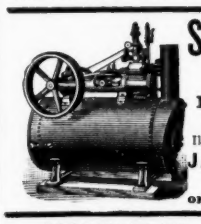

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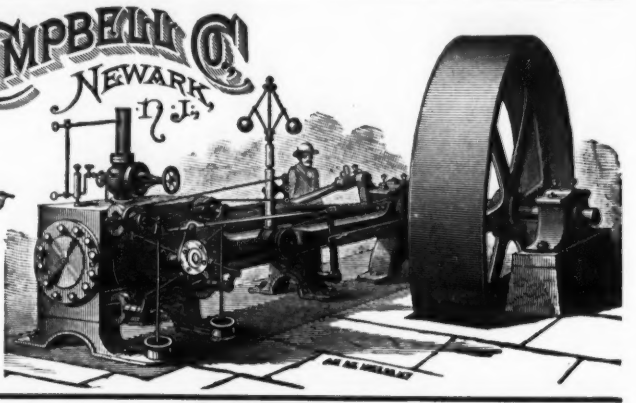

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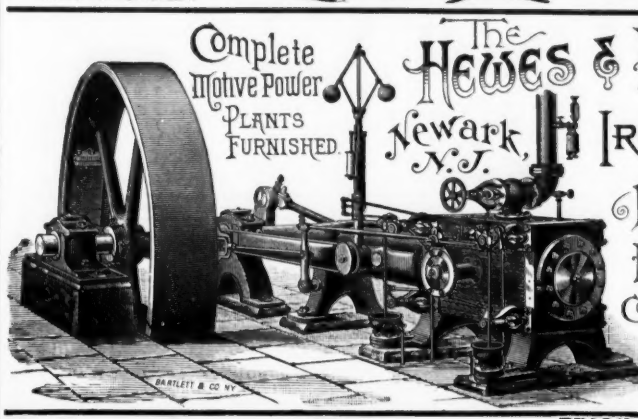

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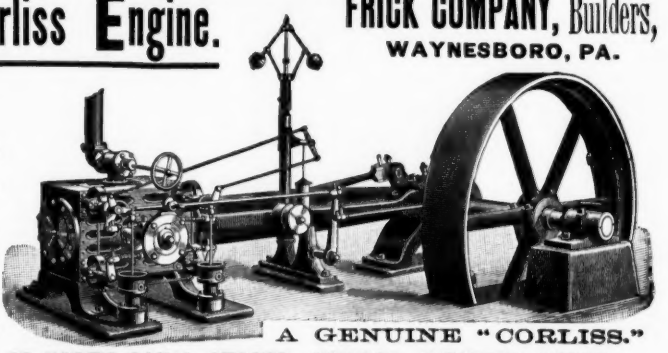

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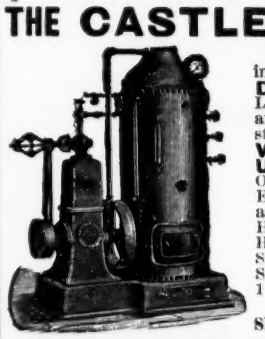

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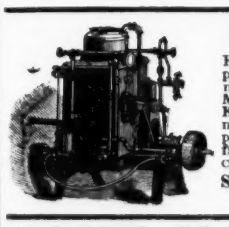

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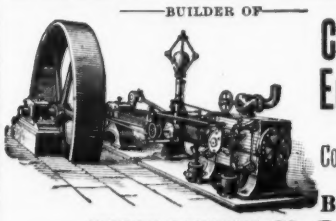

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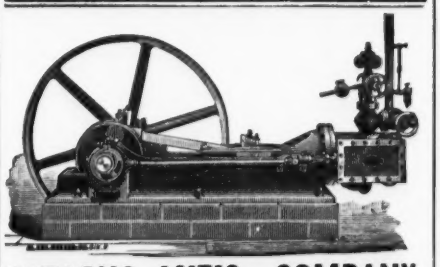

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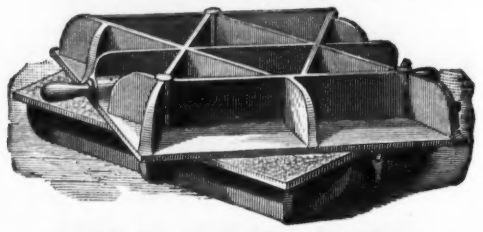

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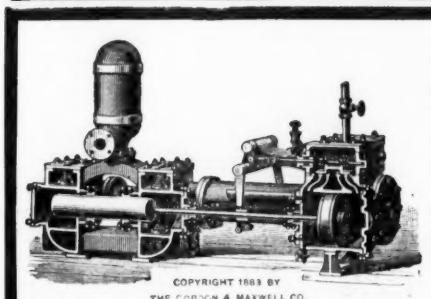

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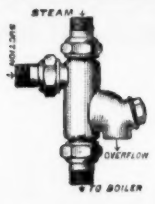

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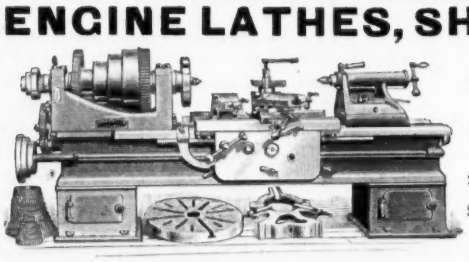

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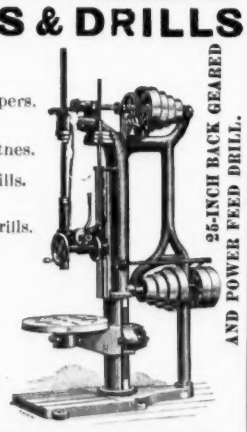

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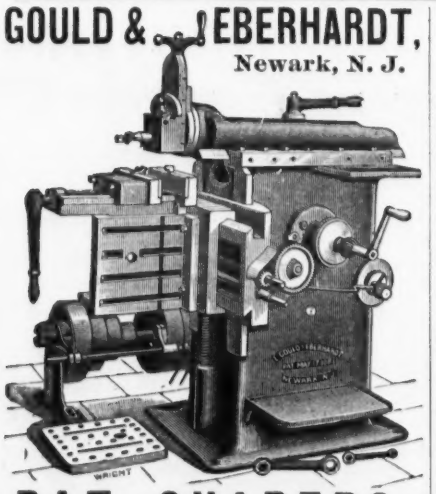

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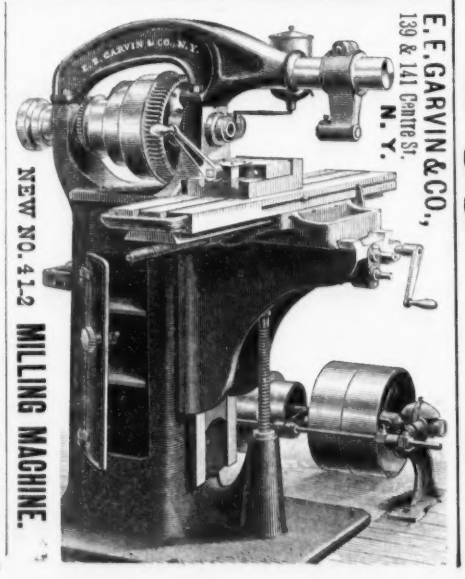

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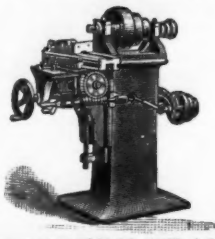

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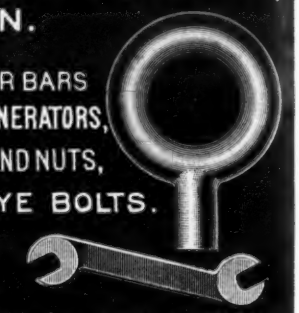

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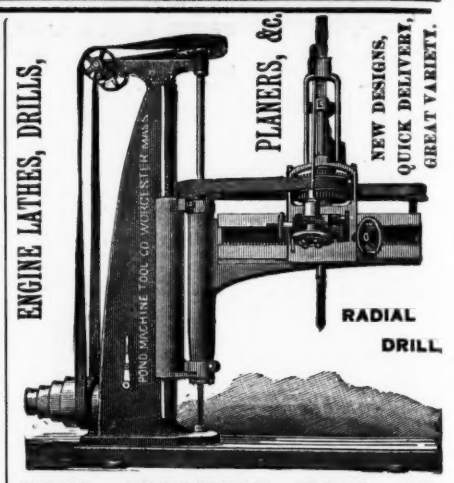

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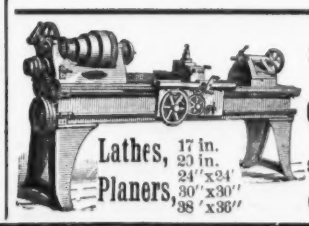

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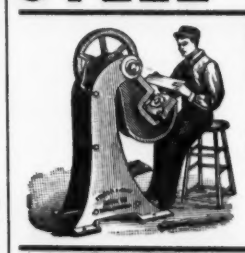

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